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THE ASCLEPIAD.

A Book of Original Research and Observation

IN THE

SCIENCE, ART, AND LITERATURE OF MEDICINE,
PREVENTIVE AND CURATIVE.

1885.

BY

Benjamin Ward Richardson, M.D., F.R.S.

TERAR DUM PROSIM.

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To

THE HONOURABLE SIR ANTHONY ASHLEY COOPER,

Earl of Shaftesbury,

WHILE YET HE LIVED THIS VOLUME OF *THE ASCLEPIAD* WAS ALREADY

DEDICATED, IN RECOGNITION OF HIS TRULY NOBLE NATURE,

AND IN ACKNOWLEDGMENT OF MANY KIND AND GRACIOUS ENCOURAGMENTS.

To his Memory,

AS

PRINCE OF GOOD WORKS,

LET THIS SIMPLE BUT EARNEST TRIBUTE OF RESPECT AND ADMIRATION

REMAIN.

PREFACE

TO THE SECOND VOLUME OF "THE ASCLEPIAD."

I PUBLISH the second volume of THE ASCLEPIAD, for the year 1885, with feelings of unmingled satisfaction.

It has been a true pleasure to write every sentence; a pleasure enhanced beyond all that I can express by the kind and friendly appreciation with which the various numbers, as they have appeared in the serial form, have been accepted, not only by my professional brethren, but by scholars in other departments, whose good opinion is of vital encouragement for future labours.

BENJAMIN WARD RICHARDSON.

25, MANCHESTER SQUARE, LONDON, W.
October 4th, 1885.

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LOCAL SYNCOPE, OR SUSPENDED LIFE IN LOCAL SURFACES.

I HAVE under my care at this moment, and have had for some years, a lady who suffers, from time to time, from sudden and complete failure of the circulation in the fingers of one or other hand. To the condition thus occurring I give the name of local syncope, or suspended life in local surfaces.

This case does not stand alone in my observation. I have seen at least two other similar instances, to which I shall refer before I lay down the pen. But the particular case I refer to is so typical I shall make it the foundation of the present essay.

The patient is over fifty years of age ; she has, altogether, enjoyed fair although not robust health. She has passed through much domestic trouble ; she has been subject to many strains on the emotional faculties, and thereby to frequent disturbance of the circulation, with feeble and irregular action of the heart. She is of spare build and nervous temperament. She recalls no constitutional hereditary tendency to the particular condition under consideration ; but there has been both gout and rheumatism amongst the members of her family.

Her subjective symptoms, as she first related them to me, were briefly as follow. Pain sharp and short, occasionally, through the chest, extending down the arms, and partaking of a neuralgic character, such pain being most readily brought on by any influences of a depressing kind. The pain was never sufficiently prolonged to cause the patient to keep the house, nor to separate her from her usual duties as mistress of her house; neither had it ever partaken of angina nor of general faintness. Her appetite was fair, as a rule, and her sleep good, unless when she was troubled by worry or unusual fatigue. Her mental faculties were natural and active, her memory excellent, and her spirits generally cheerful.

Her physical strength was not robust, but slight, and rather easily exhausted.

The objective symptoms were, except in one respect, favourable. The temperature was normal. The heart sounds were clear, but the action of the heart was feeble and quick, 80 per minute; the pulse responded equally with the heart in regard to tone, and was easily compressible. The lungs gave no indications of disease whatever. The alvine action, the catamenia, the renal function, were all natural. The sensory functions were equally satisfactory.

All things considered, I was led to look upon this lady as in rather delicate but fair health. The period of this observation was as far back as 1864, now rather more than twenty years ago.

But there was at that period the following peculiar and often-recurring phenomenon. Sometimes at the same moment when the pain through the chest, above described, was present, sometimes in the absence of the pain, but with a little disturbance in the circulation, there came on a peculiar change in the circulation through the fingers of one hand. The fingers, most frequently two of them only, became suddenly blanched and cold. The change was usually sudden, I may say instantaneous. It was never accompanied by any acute pain, but was followed by a sense of coldness and numbness in the affected surface. When the blanching and numbness were complete, the appearance was that, simply, of dead structure in connection with living. To the touch of an observer the blanched part was extremely cold, and when the part was pricked it was bloodless and insensible.

The period of time during which the blanching and the insensibility lasted each time was rather but not extremely variable. It would sometimes last nearly an hour, and rarely went entirely away in less than three-quarters of an hour. The restoration was not sudden, but seemed to be by a gradual reaction, unattended by pain, and also unattended by any sense of increased glow or warmth, hot-ache.

From the period I have named until now, this lady has continued under my care. I have always seen or heard from her once or twice a year, and in many years oftener. She has all through been subject to recurrence of the local syncope, and in very cold weather has been obliged to wrap up her hands warmly, exposure to cold having a direct tendency to induce the local affection. Under anxiety or fatigue the symptom is developed more frequently than when she is free from worry and in fair health; but she is never absolutely free of the attacks, and she occasionally suffers from them without premonitory sign, and without any assignable reason. The fingers of the left hand are, as a rule, most frequently affected, but there are exceptions to this rule. The corresponding fingers on either hand, third and fourth, are those most commonly attacked.

I witnessed the same phenomenon in a member of my own profession, the late Mr. Henry Hudson, of whom I was, in my early youth, a pupil. Long after I had settled in London, Mr. Hudson also came to London, and settled down in general practice. In 1868 he consulted me for the symptoms I have described, and which had, at first, alarmed him very much. In him the phenomenon occurred in the left hand only, and he had some indications of dilatation of the subclavian artery on the same side. I have seen the blanching of the second and third fingers in this case occur twice in one evening, involve the whole of the fingers, and last for half-an-hour at the time, the fingers being absolutely dead to both warmth and feeling. At the time I brought out ether spray, Mr. Hudson, who was extremely interested in all my pursuits,—taking as much pride in them as if they were his own,—had his two easily-affected fingers frozen by the spray, in order to see if they would become more bloodless and insensible than other parts of his hand and arm. There was not the least difference. At the same time he was perfectly convinced that when his hands were exposed to cold for a long time, the blanching was more readily provoked. He, like the previous patient, felt it necessary to wear very warm mittens or gloves in cold weather. Mr. Hudson, who survived his seventieth year, died of apoplexy. He was subject to the phenomenon of local syncope up to the time of his death.

I was sitting one day at the council meeting of a public society, when one of the members, who was near to me with his hand on the table, was affected in the same way, but in a less marked degree. Three of the fingers of his hand became suddenly blanched. He told me afterwards that he had many times been subjected to the same affection, but that he was not known to have any disease of the circulatory system. "It was," he said, "purely a nervous affection."

COMMENTARY.

The practical points involved in the study of these cases are three in number, namely:—(*a*) Cause; (*b*) Significance; (*c*) Treatment.

The Cause of the Phenomenon.

I confess at once, in relation to this, that I do not clearly see the cause in regard to the primary origin. There are three modes by which a similar phenomenon may be, synthetically, induced. One of these is by the sudden action of extreme cold. If ether spray be directed upon a portion of skin, there occurs, after a short time, a sudden blanching of the part, attended, as we know, by loss of sensibility. The second is by the rapid extraction of blood from a local centre. If we take two cupping glasses, so shaped at their mouths that when applied to a portion of skin a circular space is left between the two, the blood is withdrawn from the centre space, after the glasses are applied by exhaust, and the surface that is enclosed is white and insensitive. Or, if we put the hand or foot in a Junot's boot in such a way that the fingers or toes protrude from the boot, and then exhaust the boot, the fingers or toes, emptied of their blood by the exhaust, become blanched and insensitive. I have applied all these methods for the production of local anæsthesia, as is generally known. The third inducible form of bloodlessness is that which can be produced in the lungs after sudden death from the inhalation of certain narcotic or other vapours. In sudden death from an overdose of chloroform, I have seen the lungs left absolutely blanched, and, indeed, containing no trace of blood. In sudden death from an overdose of nitrite of amyl, I have witnessed precisely the same result.

The local syncope of which I have rendered a description, resembles the changes thus experimentally producible, and I think we may fairly infer that the syncope is due to some cause which excites a rapid contraction of the vessels of the minute circulation. The vessels suddenly undergo contraction, the blood they contain is emptied from them, and the parts are left bloodless and insensible.

By some influence, less clear than the action of cold, mechanical exhaustion, or the exhibition of a vapour which by diffusion acts on the blood-vessels, the minute arteries are called into sudden contraction, leading to the local syncope. The effect must be through the nervous system telling specially at the actual place where the phenomenon is observed. If the action were not purely local, if it were from a central impulse communicated along the whole length of the nervous cord, it is impossible to see how the whole of the fingers and the lower portion of the limb could escape. Whence the local impulse is derived, how it is derived, I do not understand.

The Significance of the Phenomenon.

The significance of the phenomenon is hardly as yet definable. I have not seen a sufficient number of examples of it to be able to suggest that the symptom is one of danger. All I can say is that in every instance I have seen there was frequent disturbance of the circulation, and a feeble condition leading to general exhaustion, at which times the local failure was most easily developed. On no occasion was the local syncope followed by any bad effect of a permanent kind. There was never any painful reaction, slough, ulcer, or after deficiency of muscular power.

Treatment.

In treatment I was careful in each case to suggest prevention of excitement and exhausting fatigue, with attention to diet, sleep, healthy exercise, and correctives for the secretions when they were disordered. I also specially enjoined that the hands should always be washed in tepid or warm water, and that they should be kept warm by the wearing of soft gloves, loose, and of porous material.

Mr. Hudson, who expressed to me a wish that I should one day publish his case, was of opinion that variation of temperature had more to do with the production of the phenomenon than any other excitement; and being a very earnest student of electrical science all his life, he many times commenced to observe whether changes in the electrical conditions of the air, connected with thermal variations, had any causative influence. I regret, however, that he left no records bearing upon this part of the subject of local syncope. He often speculated why his toes, which were furthest from the centre of the circulation, were not stricken in a similar manner, but no thought or sensation ever led him to an explanation why the fingers were exceptionally affected.

THE TREATMENT OF CHOLERA,

SANITARY, DIETETIC, CURATIVE.

THE temptation is very great to enter on the current debatable subject, the cause of cholera. It is indeed difficult for one who holds anything like decided views on this subject to remain silent. I refrain, nevertheless, because at the present moment to venture to question the wisdom that is emanating from the confusion of tongues anent the bacillus controversy would be to speak to the winds and make confusion worse confounded.

Let me then, picking up the lessons of a practical character derived from the personal study of the disease on the three latest occasions when it has visited this country, confine myself to the all-important question of the treatment of the disease.

The treatment of cholera divides itself, naturally, into three parts :—(1) the sanitary or hygienic ; (2) the dietetic ; (3) the curative.

THE SANITARY OR HYGIENIC TREATMENT.

It seems to me essential, whenever it is possible, to treat the patient at his own home. The plan of transporting patients to a distance, or into hospitals, is most critical. The motion keeps up the intestinal disturbance, and the mental trouble engendered is extremely depressing. It is also very difficult to treat several patients at one time in one room or ward. Some are likely to die in the presence of the living, and the moral effect on the living is disastrous to a degree which has to be witnessed to be understood.

The patient, then, retained in a single room, should be induced at once to lie down at full length, with the head a little raised. He is best lying flat on the back, and he ought to be accommodated on a small iron or truckle bedstead, which should be so far removed from the walls that everyone can walk round it freely. When it can be obtained, an india-rubber sheet should be placed over the lower blanket that covers the mattress, with the lower sheet over it. An upper sheet, with two or three light blankets, should form the covering of the sick; and all should be loosely laid on, so that there may be no difficulty of movement.

The bed should be divested of unnecessary curtains and valances, and the room should be quite cleared of carpets and of stuffed furniture. By the side of the bed there should be at hand three or four enamelled iron basins and a store of small, clean, cheap cloths. The vomited fluid from the patient can be received into one of the basins without much movement. A movable vessel should also be by the bedside, to receive the excreted fluids immediately. Nothing is so good as a large iron pail containing a solution of iron sulphate. There should be put into the pail a pound of iron sulphate, and on that four quarts of water should be poured. Every vomit and every purge should be transferred at once to this pail. When the pail is getting charged, its contents can be cast down the watercloset, with more water, without letting any remaining undissolved crystals of the sulphate escape. So long as there are abundant crystals undergoing solution in the pail it is ready for use. A store of solution of the sulphate may also be advantageously kept in another vessel, and the utensils may be rinsed with that solution, and dried with one of the cloths. After use, each cloth should be torn up and burned. The dry cloths, so often required by the patient for the lips, should, in like manner, be burned at once.

The room should be freely ventilated, and in it there should always be a fire. The temperature of the air should be 64° Fahr. All fads of hanging cloths saturated with disinfecting solutions about the room are, in my opinion, useless and hurtful. They keep up dampness of the air, and encourage slovenly uncleanliness. There should always be abundance of light in the room. The direct light may be screened from the patient if he find it distressing, but the room should be flooded with light when it can be, so that no speck of impurity may escape detection. For destroying disagreeable odour there is nothing so good as the volatilisation, from time to time, of a little iodine, until the odour of the iodine is just perceptible in all parts of the room. Ten grains of iodine placed in an evaporating dish, and evaporated with a spirit lamp, is sufficient for a room 12 feet by 12 feet by 10 feet. If an evaporating dish is not at hand, the saucer part of a common flower pot will do, or a fire-shovel slightly heated over the fire may be brought out into the room and the iodine cast upon it.

HOSPITAL ACCOMMODATION.

When it is impossible to treat the infected with cholera at their own homes, the provision that is made for them by local or general authorities should be of the readiest and most accessible kind. It should be, of all things, in the neighbourhood exposed to the disease, so that there may be no great distance over which to convey the sufferers. If one room or ward must be used for several patients, each bed should be separated by ten feet of distance, should be surrounded by a screen, and have 12 feet by 12 feet by 12 feet, or 1728 cubic feet, of space.

Floor and Walls.

There is no need for any elaborate hospital preparation. The floor should be well cleansed and dried, and then treated with a coat of beeswax and turpentine. During occupation the floor should be cleaned by dry scouring with sawdust, the sawdust being swept up and burned immediately.

The walls and ceiling of the room should either be lime-washed or covered with a coat of gas tar mixed with lime. This latter yields a darkish grey colour, pleasant rather than otherwise to the sight. It can be applied direct to a stone, to a plastered or distempered, to a papered, or to a boarded wall. I once treated some cottage walls in this way with the best effect.

Fire and Temperature.

As in a room in a private house, the temperature should be maintained at 64° Fahr., and precisely the same rules should be followed, in regard to ventilation, light, and cleanliness, as have already been detailed.

Both in the private room and the hospital ward, the air should be kept free of all excess of moisture. Damp air in the neighbourhood of a patient with cholera is as hurtful to the sick as it is dangerous to those about him. The air should be dry, and constantly changed. A stove constructed after the manner of the "calorigen," by which air is drawn freely from the outside and passed over a warm surface before it is delivered into the room, would be the very best for the cholera ward, and it would be more advisable to have a series of small stoves of this kind placed in different parts, so as to sustain and equalise the temperature, than to have one large stove kept in a fixed position in a corner or end of the room. In a few hours a series of these small air-circulating stoves can be fitted in a room so systematically that the thermometer would stand at 64° Fahr. at every part.

WASHING AND CLEANSING.

All washing up and cleansing of dishes, plates, knives, spoons, and the like, which have been used by the sick, should be carried on outside the room or ward. The contents from vessels should be poured first into the sulphate of iron solution. The vessels should then be rinsed in a stream of cold water, running into the iron solution, and should not until after several rinsings be placed in boiling water. The cloths with which the different utensils are dried should be immediately plunged into cold water, well rinsed and wrung, and after being wrung thrown into boiling water. Snow, than whom no one traced out the distribution of cholera more accurately, was very strong on this matter of washing and cleansing. He took the view, which I can confirm by more than one observation, that amongst the poor the drinking utensils used by the sick are very common modes of conveyance of the cause of the disease.

In the laundry an arrangement should always be made by which the sheets and other articles of clothing about to be washed should be first freely immersed in cold water, rinsed, and afterwards thoroughly wrung dry. They should then be thrown into a copper, the water of which is boiling at the time of their immersion. Every precaution should also be taken that the steam from the water in the copper should go direct up the flue, so as not to diffuse into the laundry itself. This is most important. No persons have suffered more severely from cholera than laundresses.

Provision should be made in every case for the disposal of the water which has been used either for the bath or for cleansing the clothes of the sick. To pour such water directly down the closet or drain is unquestionably dangerous. To make its removal safe it should be added slowly to water boiling in a copper or boiler, the steam from which is being conveyed away by a proper channel. It would be a very useful invention to construct a boiler in metal, with a flue connected directly with itself from the top, in which flue the steam would have to pass over heated porous material. Into such a boiler water that has been used in the ward or bath-room could be passed through a tube gradually, so as to be rendered immediately innocuous. Through a lid in such a boiler, clothes and other fabrics could be introduced without exposing the workpeople to the vapour rising from heated but not boiling water.

DIETETIC TREATMENT.

Cool—not cold—neutral and sustaining fluids are the best foods. Cold fluids increase the cold of the body; heated fluids tend to excite vomiting. Thin chicken-broth, or milk which has been boiled and afterwards mixed with water that has also been boiled and brought down to tepidity, are excellent foods when they can be retained. Some patients prefer water or weak cool tea to everything else, and this often answers extremely well. To try to introduce solid food by the mouth is quite in vain; such food irritates, produces flatulency, and excites intestinal disturbance.

Anyone who has seen many cases of cholera will recall that, notwithstanding the vomiting, the patient may, by careful attention, be induced to take, by the mouth, a very large quantity of fluid. I have, myself, succeeded in administering a quart of fluid per hour to the person stricken with cholera; and as the complaint of thirst is a common complaint there is never much difficulty in the persuasion.

The fluid to be supplied should, on all rational grounds, be unirritating, pleasant, and sustaining. It should not be so cold as to make the body cooler by extracting heat; it should not produce local reaction by excess of heat. It should be administered after it has been raised from fifteen to twenty degrees above the animal temperature. I have seen vomiting re-excited after that symptom had considerably ceased from the simple process of administering a drink that was too heated or too stimulating.

So much for the warmth of the fluid supplied; next, as to the nature of it.

One of the old school of London physicians, Dr. Walsham, whose long practice had made him less confident than his Fellows in the use of drugs, created some surprise during the great epidemic of 1832 by stating his opinion that he had seen more success from the free administration of chicken-broth in cholera than from any other mode of treatment. I do not doubt that in a large run of cases this simple plan of treatment would be attended with excellent results.

The patient should be induced to drink slowly, and immediately after vomiting is a suitable time. If he drink slowly he may drink as freely as he please should no uneasiness nor distension be produced.

SO-CALLED STIMULANTS.

I am almost afraid to treat on the administration of alcoholic drinks in cholera, for fear that I may be accused of writing under what is called prejudice respecting those drinks. But it would be cowardly on that account to suppress what I feel to be most importantly true, namely, that the use of such drinks in any form is systematically pernicious in cholera. Years before I held the views respecting alcohol which I now hold, I had learned by what I had observed, first, that no good whatever follows the use of alcohol in cholera, and, secondly, that the local stimulation it causes excites vomiting, induces a febrile excitement, and favours after-prostration. It was difficult to keep alcohol-drinkers from taking it freely, and it was too easy to detect that these persons were they who died most frequently and rapidly. How any authority could recommend such a vile admixture as brandy-punch for the indiscriminate use of people falling ill with cholera I am utterly at a loss to understand, nor can I either from the practical or physiological side see any place for alcoholic drinks in the treatment.

MEDICINAL TREATMENT IN THE FIRST STAGE.

Without suggesting that fear may be a cause of true malignant cholera, I am quite sure that fear is a frequent cause of intensification of the symptoms; and that a cheerful countenance and an assuring word by the medical attendant is a splendid prescription. I put this first because that is its true place.

Frequent visits by the medical attendant are all-important. I am as certain as I can be of anything in practice that, in 1854, I was the means of saving four cases by attention to this rule of practice. As far as I could, I visited each serious case every two hours. I then saw that all directions were being carried out faithfully. I encouraged the attendants to hold on steadily, and not to be alarmed. I saw that the utensils into which the discharges were received were carefully cleansed, and that the cloths used for drying the earthenware cups and basins for the patient were not used for other purposes. I saw that the air of the room was at a proper temperature, and that the patient was not only kept quietly recumbent, but that food and medicine were duly administered.

In cases where it is clearly shown that the symptoms have followed indulgence in any kind of food or fruit that has created stomachic or intestinal derangement, I have always found it good practice to administer a dose of castor oil, and, if necessary, to repeat the dose. After Dr. George Johnson's essay on administration of castor oil I was bolder than before as to this plan, and, I think, with favourable results. So soon as the oil has acted by the bowels—for, singularly enough, it rarely excites vomiting—I have given in every case a mixture containing creasote, opium, and camphor. The following is a good form:—Pure creasote, ♏xij.; compound tincture of camphor, ʒss.; pure glycerine, ʒss.; distilled water, ss.—to make a mixture of twelve doses, of which one fluid drachm in a wineglassful of water may be taken every hour until the vomitings and the discharges from the bowels are relieved.*

The first suggestion for the use of creasote in cholera was made by my late friend, Mr. H. Stephens, of Finchley, the favourite fellow-student of Keats the poet, and himself a man of original genius. It was afterwards, and quite independently, introduced and used with remarkable success, in 1848, by my friend and once fellow-student, Mr. C. N. Spinks, of Warrington; and in 1850 the use of it formed the subject of an essay from my own pen in the old *Medical Gazette* during the editorship of the late Dr. Alfred Swaine Taylor. On the question of this line of medicinal treatment I have never seen the slightest occasion to change my views. Creasote in small repeated doses, in combination with opium and camphor, as formulated above, checks the choleraic discharge, relieves the spasm, and is the most demonstrably curative of any remedy I have known.

The remedy should be continued throughout the attack. It should be administered always slowly, with an agreeable quantity of water that has either been distilled or boiled and cooled; and should it be ejected immediately after being swallowed it should be repeated so soon as the vomiting has ceased.

TREATMENT IN COLLAPSE.

The lines of treatment in collapse as they have appeared, and appear to me, are much the same as should be pursued in cases of exposure to extreme cold, where the body has been brought to several degrees below the natural standard of heat, and where, owing to the cold, the surface of the body is blue, the blood all but stagnant, and the consciousness reduced or lost. In such a case it would be folly to charge the affected person with cold iced drinks, for by such means the temperature of the body would, possibly, be further reduced. In such a case it would be folly to plunge the person into a hot bath, for although there might, thereupon, be a sudden reaction, there would be no source of supply of heat, but merely a heat shock or stroke, under which the remaining vital powers would be called into sudden activity, to cease directly in death, the glacial form of inaction and rigidity,—which is not of necessity fatal,—being transformed into the pectous change, or true rigor mortis of the nervous, vascular, and muscular fluids, from which there is no known mode of resolution. In such a case it would, as it seems to me, be also useless to place the affected person in the hot-air bath, because exposure to heated air, under conditions in which the capacity of the blood to circulate freely is lost, would only tend to increase the danger of coagulation of the blood in the body, and, by quickening evaporation of water from the respiratory surfaces, to intensify the exhaustion of water from the body.

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* This form, prescribed by me for an ingenious English lady who recovered from a severe choleraic attack, was carried by her to Southern America, and was used by her there, in a district where there was deficient medical assistance, with such good effects, that she became, during an epidemic outbreak, a noted healer amongst the native population, and netted no inconsiderable sum of money, as well as kudos, for her skill.

The first point of practice in the collapse is, then, I think, to place the sufferer in a medium temperature, not below 60° and not above 66° Fahr., so that neither the chilling action of cold nor the exhausting action of heat should exert a destructive influence; though heat, I take it, is really the more dangerous of the two, a suspicion which the experience of cholera in tropical temperatures too fully confirms.

When, in spite of all that we can do by administration of medicines by the mouth, and the other measures above suggested, the collapse continues, is there anything more that we can do with the legitimate hope of success? Can we, by what may be called last and extreme resources, save life? The question is one of the most solemn.

It is just at once to admit that in some cases of collapse the discharges from the alimentary canal cease some time before death; and from this calm I have two or three times seen an altogether unexpected recovery, the patients, who have been left as hopeless, making slow but safe return to health. The fact here named has strongly impressed many of our best observers, and has led some of them to feel that, taking it all in all, a patient in the last stages of collapse may have better chances of recovery by being left to what seems his fate than by being subjected to a doubtful line of restorative treatment.

For my own part I agree with the view thus expressed so long as the treatment remains doubtful. The question we have to solve is:—Can the doubtful be made the certain or more certain?

In studying this question, the facts of the calm which accompanies the approach to death, and of the occasional recovery under such condition, should be constantly kept in mind.

The cessation of the drain from the alimentary surface is due to the state of the tissues and of the blood of the affected. The blood extremely condensed, and the tissues deprived of water, the discharge ceases by necessity. Then the condensed blood, if it can circulate at all, greedily re-absorbs water, and gaining, very slowly, more volume, restores, also very slowly, the vital functions, leaving the alimentary canal free from pressure of fluid, and in a state of rest, favourable to recovery.

The vital point to determine is whether we shall rest content with these occasional spontaneous recoveries, or whether we shall endeavour to replace the lost fluid by injection through the venous system. Let us study the point by the light we have so far obtained.

SALINE INJECTION.

Up to this time we have been content to inject warm saline solutions into the veins. The results have been often astounding, very often delusive. In some instances it has seemed as if the injection has restored the dead to life, but the collapse has only too surely recurred. In a case which I attended with the late Mr. Ancell and Dr. (afterwards Sir) John Cormack, in 1854, we injected into the veins of a collapsed woman two pints of warm saline solution four successive times, and each time with the effect of restoring her from apparent death to consciousness and power of movement, thus evidently extending her life over thirty hours, but only for her to die at last actually exsanguine.

When, in this state of collapse, we inject a warm saline solution, we very quickly revivify the heart by the warmth; we dilute the condensed blood, we increase the volume of blood; but we put direct pressure immediately upon the alimentary surface; and, thereupon, we reproduce the discharge.

It is like producing a secondary hæmorrhage.

There is an experimental fact which I have twice before published, and which bears directly on the point now in hand. I have shown that if we take an animal that is just dead from chloroform, and inject warm watery or saline solutions into its circulation by the aorta, the abdominal viscera, as the parts the least resistant, are the parts which receive nearly the whole of the injection, the intestines alone receiving more than half the weight of the fluid. So when we inject the veins in cholera, after the fluid has been carried over the lungs to the left heart, it is injected by the left heart mainly into the intestinal surfaces, from whence, in cholera, it finds a ready escape from the body.

The two sets of facts,—the one of occasional slow spontaneous recovery, the other of temporary rapid reanimation under injection of saline solutions in cholera,—throw light on each other. They indicate that injection by the veins ought not to be a process of forcing a large quantity of fluid direct into the circulation, but a quantity sufficient to dilute the condensed blood and to enable the blood to traverse once again its natural courses, with as moderate a pressure as can be obtained, and without undergoing an excessive fluidity.

The effects of saline injection can never be forgotten by those who have once seen them. They indicate clearly that the plan is important in principle, faulty in detail. If a person apparently dead from the collapse can be raised back to consciousness and to other signs of renewed life, why should not the reanimation be sustained?

The general impression as to the cause of failure has been that the injected fluid is thrown—if I may use such an expression—into a leaking vessel. The fluid fulfils certain purposes of life for a short time: it supplies warmth; it dilutes the condensed blood; it enables the blood to course more freely through the vessels; and upon these changes the phenomena of reanimation are presented. But as the temporary recovery from the collapse becomes developed, so, following upon it, the symptoms and causes of collapse recur. In other words, with the recovery there is return of the profuse discharge from the alimentary canal. In Mr. Ancell's case we had no doubt at all that during the last collapse which passed into death we could have brought back a short flickering of life, and as the tube for injecting was still tied in the vein we were much tempted to do it. We were stopped by the feeling that it were both useless and cruel to wake up the practically dead body to momentary existence, and permit it, with pain and fear, to die again. So we withheld our art because it was a broken reed.

Saline injection failing, the next rational research is after a fluid which, being gradually and steadily transfused, will keep the animal fire alive while time is given for the alimentary affection, whatever the nature of it may be, to run its course and cease—a result which would be all but certain, in the majority of cases, if time could be gained.

TRANSFUSION OF BLOOD.

The mind first refers to blood as the fluid which of all fluids would answer the purpose. The objections to it are too many to permit of its recommendation as a practical method.

In the first place, during the existence of an epidemic people are so panic-stricken the physician could never depend on supplies of blood from the unaffected. In the next place, it is not by the injection of a large quantity of blood at one time that the service which is required can be insured. In the third place, blood in its total is not the fluid that is wanted. If, while being injected, the blood coagulates ever so slightly, if it form ever so small a clot, it sets up the risk of causing a general coagulation in the volume of the affected blood already in trembling equilibrium. Again, in the blood remaining in the body of the affected, there is still the corpuscular matter and the fibrinous, so that more corpuscle and more fibrine are not wanted, but a fluid that will gradually dilute and restore what remains in the vessels. Could we by some excellent device separate the serum of blood flowing from the vein of a healthy person, and slowly infuse that part, we might expect the best results. That would be a scientific procedure. Could we add chyle to the serum the procedure would be more theoretically perfect. We should then, as we injected, be giving the collapsed man an external alimentary system, and should be putting him into a condition in which it would be difficult for him to die. He has lost for the time his alimentary system. We should lend him one.

TRANSFUSION OF MILK INTO THE VEINS.

My late friend Dr. W. Bird Herepath, of Bristol, suggested in the pages of the *Association Medical Journal*, the transfusion of milk in cases of cholera. This suggestion was made on September 1st, 1854, but I am not aware that the practice was adopted by anyone in our country. In Canada, however, the same suggestion occurred, I believe quite independently, to Dr. James Bovell, of Toronto, and he was bold enough to put the plan to the test of practical experiment. In an essay which he read before the Canadian Institute, and afterwards published in a separate form, Dr. Bovell gave a history of six cases treated during their last stages by the transfusion into the veins of freshly drawn cow's milk. In two of these cases, which seem to have been extreme in character, and hopeless, the treatment was followed by recovery. The others died, but they too appear to have been benefited for a short period.

It is to be observed that in these cases Bovell injected comparatively small quantities of milk. In one of his successful cases he threw in twelve ounces, in another eight only. These, nevertheless, may have proved quite sufficient quantities to have saved the life, for the process was one of feeding by the veins. Moreover, the results were, without any doubt, better than those which have usually followed injections of saline solutions, recoveries of two in six being no contemptible success.

The disadvantages connected with milk seem to me to be twofold. I found by the experiment of mixing milk with blood that the milk does not hold the blood-corpuscles in good suspension. I also found that when fresh defibrinated blood warmed to 100° Fahr. was mixed with fresh milk at the same temperature, there was very quick coagulation of the caseine, so that the combined fluids did not flow readily through the injecting needle.

At the same time Bovell's practice deserves to be well remembered, for it may be that milk might prove an admirable basis for a feeding fluid by the veins. It might be advisable to charge milk with saline substance, or with saline substance and some other body, —say glycerine, or solution of grape sugar,—which would have the tendency to prevent the objections to which I have referred. The addition of phosphate of soda in the proportion of twenty grains to a pint of new milk from which the caseine had been precipitated, with the further addition of two fluid drachms of glycerine, would prove a good menstruum for diluting the blood in the vessels, for the suspension of the corpuscles, and for sustaining animal life. Such solution, warmed to the blood temperature, and slowly injected, would be admirably adapted to the treatment of the collapse by intra-venous injection.

AN ARTIFICIAL SERUM.

In 1866 I conducted a long research in order to discover a fluid which would most determinately take up and distribute the corpuscles of a blood that had been condensed by the slow evaporation of one-third of its water. The compound which yielded the best response to this inquiry was made as follows:—Of white of egg four ounces by weight; of common salt one drachm; of phosphate of soda one scruple; of clarified animal fat one ounce; of pure glycerine two ounces; of water sufficient to make one pint. In preparing, I dissolved the common salt and phosphate of soda in the water, and having well whipped the albumen, added that also to the water. I placed the mixture on a water-bath, and raised the temperature to 135°; keeping the mixture steadily stirred, and digesting at this temperature for one hour. This yielded an artificial serum, the albumen of which hydrated freely. Having taken the artificial serum off the bath, I put the fat and the glycerine together in a crucible, and melted the fat in the glycerine. When the process of solution of fat was complete, I poured the solution at 120° Fahr. into the artificial serum, stirred carefully, set aside that the fluid might cool to 80° Fahr., at which point all the fat that was insoluble at 80° floated on the surface and was filtered off carefully.

The fluid thus obtained was of pinkish colour, of saline, sweetish taste, and of specific gravity 1038. It picked up semi-fluid blood with instant readiness, and diffused it most equally. Heated, it took up one-third more caloric than water in the same time; and in cooling it restored nearly one-third more.

The fluid here described would, I believe, prove most serviceable for feeding by the veins during the collapse, if it were slowly injected in proportions of not more than four to six ounces at each injection.

ON MODE OF TRANSFUSION.

I have a word to say in reference to the mode of injecting the veins. The greatest mischief has arisen in transfusion from errors in the process. The operator should ever remember that in this operation he is feeding, not forcing; he should keep in mind how gradually nature feeds the veins by the thoracic duct, and should imitate her. There is no necessity for force, none for hurry.

Above all things, in feeding by the veins, the syringe should be thrown aside; it is a dangerous and bad instrument for the purpose. To replace it I constructed a simple instrument, which consists of a glass cylinder with a flexible tube running from its lower part or chamber for insertion, by means of a quill or hollow probe, into the vein to be injected. The upper part of the cylinder is provided with a stopper, through which a tube passes, connected with a small pair of hand-bellows. Within the cylinder is a small hollow ball or safety-valve regulator, which floats, if there be fluid in the cylinder, until the fluid allows it to descend to a constricted lower part of the cylinder, when all further passage of fluid is prevented. The flow of liquid along the escape-tube can be checked or set at liberty at pleasure by a spring-clip.

In using this instrument, the warm fluid to be injected is placed in the cylinder, and a little is allowed to run through the escape-tube to displace all the air; next, the escape-tube is closed by means of the clip. Then, having opened the vein while it is being pressed upon from above, the quill or hollow probe at the end of the escape-tube is inserted and fixed, and, when all is ready for the fluid to flow, the clip is removed, and the cylinder raised one or two feet above the patient. The pressure so induced will now usually suffice to force the fluid into the body equally and gently; but, if there be any obstruction, the merest pressure of the lower fall of the hand-bellows will remove it. As the fluid descends, the hollow ball goes down with it to within three inches of the bottom of the cylinder, where it is opposed by the constricted neck. The neck is so effectually closed by the ball valve, that no air can possibly pass it to get into the vein.

A diagram and description of this instrument will be found in a report to the British Association for the Advancement of Science, at the Nottingham meeting—vol. xxxvi., p. 174—for the year 1866.

TREATMENT BY INJECTION OF THE PERITONEUM, OR OF THE CELLULAR TISSUE, DURING COLLAPSE.

When the cholera epidemic was present in the year 1854, the idea occurred to me to supply the waste of water from the body of the collapsed patient by injecting water either into the peritoneum or into the cellular tissue.

I communicated this suggestion to the East Surrey Society for the Investigation of Cholera, at a meeting of the Society held at the Children's Hospital in the Waterloo Road, on August 22nd, 1854, and I published it in the *Association Medical Journal.** As it gave rise to considerable discussion, I afterwards, by the approval of the members of the Society, republished the essay in a separate form.

I found in this original research that distilled water warmed to the temperature of the body might be injected without the slightest danger, either into the peritoneum or into the cellular tissue of warm-blooded animals, provided that the quantity injected was limited in amount to less than a fifth part of the weight of the body of the animal. I found also that when the body was greatly reduced from removal of fluid, water injected into the parts described was almost immediately absorbed, and that the peritoneum was a sac from which the absorption of very large quantities of water would take place without mischief.

The practice was tried in two cases of cholera in man. In one case under my own care, eight pints of water were injected into the peritoneum of a patient in collapse; and in another case, ten pints were injected by a practitioner in Wiltshire whose name I have unfortunately forgotten. In both cases the patients recovered, but in neither was the collapse so complete as to convey the positive assurance that recovery might not have taken place if the injection had not been made.

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* "Suggestions for the Treatment of Cholera in the Stage of Collapse by the Artificial Production of Peritoneal or Cellular Dropsy." By Benjamin W. Richardson, M.D., *Association Medical Journal*, August 1854.

My suggestion was carried beyond the mere injection of water to that of introducing foods or medicines by the peritoneum or by the cellular tissue, both of which suggestions have been advanced since by others, as if they were original ideas and practices.

In order to carry out the injection into the peritoneum, I proposed that the opening into the peritoneum should be made with the point of a scalpel, through the linea alba, about two inches below the umbilicus. The blunt end of a small catheter was then to be introduced while fluid was running through it, so as to prevent the admission of air, and the freedom with which the fluid flowed into the cavity was to be taken as evidence that the peritoneum had been pierced. The injection was directed to be carried out by a double acting syringe like that used for the stomach pump.

It was in this way that I injected the eight pints of distilled water, warmed to blood heat, in the only case in which I put the practice to the test. The operation caused no pain, nor, indeed, inconvenience, and although we have since 1854 made many improvements in the way of injecting needles and injecting apparatus, I am not sure whether the simple plan I have described is not as safe as any other.

It is, I think, a pity that the plan of injecting water into the peritoneum in collapse was not extensively tried in the late epidemic on the Continent. My good friend, Mr. Cameron Macdowell, to whose mind this system had recommended itself, but who, with singular frankness, resigned the priority to me on reading the *Lancet* comments upon it last year, consulted me on the subject of the operation, and then proceeded to the Continent to endeavour to carry the plan out. I have not heard the result of his endeavours.

We stand, therefore, at present in the position of knowing that the peritoneum may be injected with a large quantity of water in the collapse of cholera; that the water injected will be absorbed; and that the patient may recover. I do not presume that the information gives ground for the assurance that cholera may be very successfully treated by this plan; but I claim that sufficient has been shown to indicate that a very impartial and extended experience could be made of it, in the last stages of the fatal malady, without any risk to the patient, and with hope of benefit.

Another suggestion I have offered is that the urinary bladder might be injected with water, during the collapse. I do not press this suggestion. Neither do I press injection of the cellular tissue.

PROPOSITION OF AN INTRA-PERITONEAL STYPTIC AND SEDATIVE INJECTION IN CHOLERA.

I have now to propose for the first time a much bolder and more radical method of treatment by the peritoneum.

In my experimental researches on the synthesis of rheumatism, I found that dilute solutions of lactic acid could be introduced by the peritoneum, without creating any such degree of local lesion as was expected. I believe, therefore, that in extreme cases of cholera the peritoneum might well be used for the direct reception of astringent and sedative remedies.

A water solution of tannin, made by adding a scruple of tannin to a pint of warm distilled water, with ten minims of solution of opium, equalling a grain of opium, might be injected into the peritoneum with the utmost safety, and, I think, with good effect. The tannin would dialyse rapidly into the intestinal canal through the intestinal membranes, and would exert an instant styptic action by arresting the profuse secretion; while the opium, also quickly diffused and absorbed, would be most valuable as a sedative.

I name tannin as the styptic in this case, because of its freedom from irritating properties, and because, in the body, it is transformed ultimately into a perfectly harmless product—grape sugar—which would find its exit from the body by the urine, unless it were used up in combustion as a hydrocarbon. This same plan might be used with hopeful results in the last stages of typhoid, especially when those stages are accompanied by profuse hæmorrhage.

In the use of the styptic solution the ordinary small hypodermic needle could be employed, the quantity of fluid wanted for injection being small, and the course of the injection slow. The rapidity of the dialysis from the intestinal surface into the intestinal canal would, I opine, safely prevent the action of the styptic on the blood in the underlying large abdominal veins, the only great source of danger from the operation.

TREATMENT OF CHOLERA IN THE STAGE OF REACTION.

The last subject I have to mention relates to the treatment of cholera in those cases where the collapse has ceased, and where the stage of reaction has fairly set in.

I doubt if there be any stage of cholera in which more careful treatment is demanded than the stage of reaction. One is very apt to be deceived by the transition from the cold stage of collapse to the stage of fever. At first all seems well. The cold extremities become warm; the cold breath, so characteristic of cholera that it would yield a diagnosis almost of itself to those who have seen cholera, is again natural; the cramps have ceased; the mind of the patient is easy; the anxious, shrunken expression has departed; the voice has lost its bleating sadness; everything bids fair for recovery. An hour or two passes, and all is changed; there is intense fever, dry skin, parched tongue, nausea, often delirium, and too often a second collapse, assuming the typhoid type.

The reaction is as close as it can be to that which succeeds exposure to extreme cold or starvation, and the treatment for it is practically the same.

When the stage of collapse has decidedly passed away, the safest practice is to prevent every artificial means of stimulation. Hot drinks, rich foods, alcoholic stimulants, over-clothing, over-heating of the air of the room, are all to be specially avoided. The patient may continue to drink cool watery fluids, he may be allowed watery fruits like melon, but he must not be rapidly fed. He may be relieved of medicine. He must be allowed to rest and sleep.

Medicinally, ammonia, largely diluted with water and milk, is the agent most likely to retain the fluidity of the blood and prevent septic change. Or ammonia may be exhibited by inhalation in the form of ammoniated chloroform, after the manner I have recently suggested for the reduction of zymotic pyrexia.

ON THE INFLUENCE OF EXTREME COLD ON NERVOUS FIBRE.[*]

WHEN a compound nerve-cord like the ulnar nerve is subjected to extreme cold in a gradational manner by freezing, there is first subjectively evoked some over-action, causing a painful sensation towards the distal extremity of the limb. At the same time the will controls the muscular motion, and there is no trace of convulsion. When a portion of nerve becomes actually frozen, sensation is entirely destroyed at the part acted upon, and, as I learned by the operation of nerving in the horse, the frozen nerve-cord may be cut through without any pain whatever being indicated. The same is true, also, in the human subject, a fact I have witnessed during operations where a frozen nerve-trunk has been divided. The first signs presented under the freezing are striking. At first the nerve is seen slightly coloured, then it suddenly becomes intensely white, very hard, and, I had almost said, of dull metallic lustre. This occurs whether the nerve be living or be just dead. In time the nerve relaxes as the cold is withdrawn, and resumes, with little so-called reaction, its natural appearance.

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[*] From a lecture delivered on Tuesday, May 7th, 1867.

And here let me explain a new and curious fact in reference to the power of the nerve trunk to convey an electrical current. To carry us from step to step, we will start with a portion of desiccated nerve that has been removed from an animal recently dead. The nerve has been dried at a temperature below 100°. We try to make this dried nerve form a portion of a circuit of a weak continuous galvanic current from one of Pulvermacher's chains. We test for the current with a large but delicate galvanometer, and the result is that we find no indication of transmission of current. We turn to a small and much more delicate galvanometer, and still there is no current. The desiccated nerve does not conduct, and the current is arrested in its course. We take now a portion of fresh moist nerve, and place it in a glass tube. We try to make this piece of nerve form part of the circuit of a feeble galvanic current, and we test for the current. We see at once the deflection of the needle of the large galvanometer; the needle moves twenty-six degrees on the dial. This nerve matter, consisting of water, fat, and albumen, conducts; it does not conduct like a metallic wire, but it conducts well.

We will make a third change: we will take a portion of fresh nerve fibre, placed in a glass tube, as in last experiment, and freeze it as fully as we should need to freeze it if we wanted in the living body to cut off sensation by the process. We now test again for the electrical current, making the nerve act as a part of the circuit, and although this time I shall fail to show a current with the large galvanometer, I shall find that in the smaller and more delicate instrument the needle moves twenty-five degrees, showing clearly the passage of a current. In this experiment we have an analogous phenomenon to that which occurs when, pressure of a mechanical kind having been applied to a nerve, an electrical current can still be transmitted through the compressed part. By pressure we can cut off all sensation, but yet, when we test the conducting power, we find there is still a passage of the galvanic current.

We must not, however, spring at the conclusion that we cannot by any degree of cold stop the transmission of the electric current through the nerve. We can stop it by continuing the freezing process until every portion of the nerve is rendered equally inert, and all the water of the nerve-tissue is converted into ice. Then nerve matter becomes composed of two separate constituents, both imperfect conductors, so-called non-conductors—viz., of water in the form of ice and of solid nerve matter. In this state the nerve is virtually disorganised—that is to say, its natural parts are disarranged and altered in physical quality, upon which there is no conduction of electricity. In this case again, pressure may afford us an analogous condition—that is to say, if we carry pressure on nerve to the extent of breaking up the nerve-tissue and disorganizing it, we destroy the power of transmission. At the same time there is a marked difference of result; the frozen nerve by care in its treatment will recover at once, but the nerve injured by pressure is usually injured beyond recovery.

Experiments on the influence of galvanic action on frozen nerve may be made with effect and with wonderful precision in a living animal rendered, for the time, entirely dead to pain by general anæsthesia. If in this condition the sciatic nerve of a large rabbit be laid bare, and, without dividing it, a feeble galvanic current be passed through a portion of the nerve (say half an inch) well insulated, the galvanometer will demonstrate the free passage of the current, and, coincidentally with the deflection of the needle, there will be a convulsive twitch in the muscles of the limb supplied by the nerve. If we now freeze the nerve in the part included by the needles, we can watch all the gradations from the natural state up to the state of absolute freezing of every part of the nerve-cord. At first the needle will be deflected, full forty degrees, and the muscles, with each make or break of contact of the battery, will twitch vigorously. As the chilling progresses, the action of the needle will continue until the moment of actual freezing; and even then, although the nerve is temporarily dead, there will be some indication of current by the needle, and some indication of movement in the muscles. At last, the extremest degree of freezing having been carried to every portion of the nerve fibre, the needle will stand motionless, and the muscles, the same as the needle, will forbear to give any sign of action.

In this inactive state we can hold the parts for long periods of time if we please, and then, by withdrawing the cold and allowing slow reaction, we can restore them to their natural functions.

Thus we learn that the function of a compound nerve can be destroyed as effectually by extreme of cold as it can be by excessive pressure, or even by actual division. But there is this grand difference: in the first case the structure of the nerve is dangerously injured, if it be not actually destroyed; while in the latter case there is no positive injury, but merely and solely a temporary, though for the time total, extinction of function. These effects of cold on the animal body seem to me to be developed in every part, in every structure. By removing heat we destroy action, or, in other words, those phenomena which exhibit matter under the influence of force; but we in no way injure matter so as to disable it from further work. Resupply it with the force taken from it, and it is as ready again for function as if nothing had happened to it.

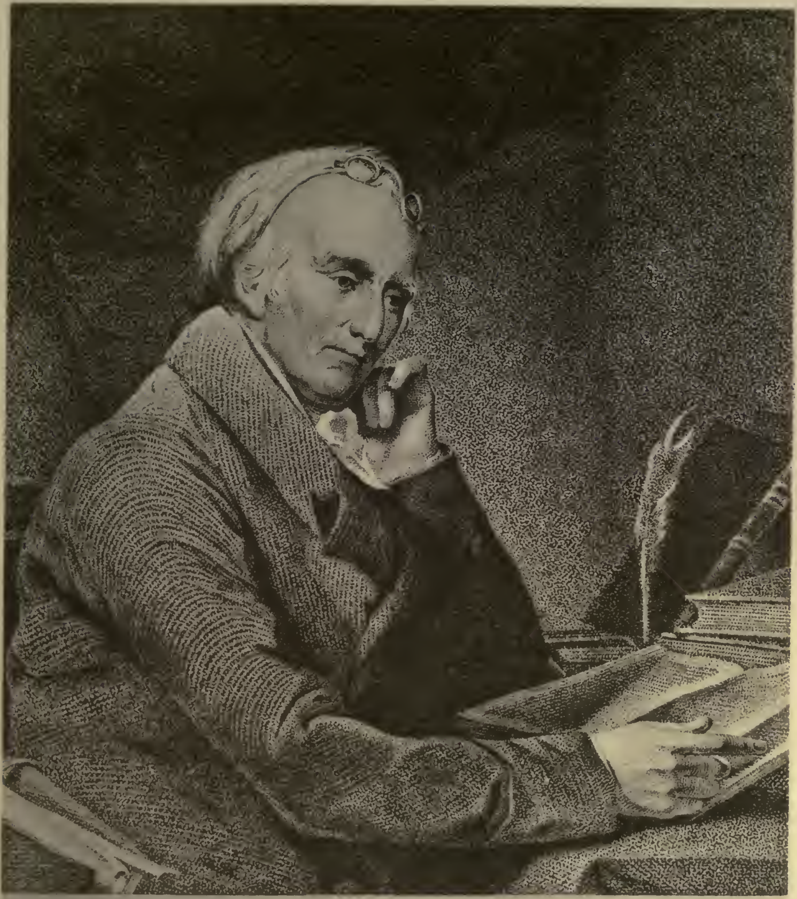
If we pass from nerves of a compound character to nerves supplying semi-voluntary muscles or voluntary muscles, the objective changes in the nerve itself are the same as before stated in relation to compound nerves. But there are other phenomena of a remote kind developed in the muscular parts supplied by the nerve. Thus, if, under anæsthesia, we lay bare the phrenic nerve and apply the spray to a section of it, there is at first excitation of the diaphragm, like singultus. In time this action becomes subdued, and as the nerve is frozen through its entire structure, there is sudden cessation of movement of the diaphragm and rigidity of the muscle which lasts until the nerve is thawed, when the natural action is restored.

The above observations, made in 1867, will bear study by the side of those on electrical conduction and resistance, published in THE ASCLEPIAD for April last, Vol. I., Pp. 120-137. By comparing the two papers we are led to ask, What is it in living nervous fibre that conducts an electric current? The answer seems to be that water is the sole conductor. Upon which another question arises:—Can the water be so arranged as to be insulated within the nerve?

THE AMERICAN SYDENHAM,—BENJAMIN RUSH, M.D.

GREAT events and great men are twin relations. In the natural ordination this fact is ever declaring itself, and never was it more clearly declared than in the period of that great revolution which gave to the American States their united independence. In that struggle for freedom the men who wrought the change came to the front as if they were called, each specially fitted for the duty he had to perform, and doing it as well as it could be done.

If the pleasures of hero-worship were not so overwhelming there would be nothing whatever peculiar in these combinations, inasmuch as great men are always present when they are wanted and called for. But, like the crowds at a theatre who concentrate all their admiration on the actors without thought of the playwright, whose creations and instruments the actors are, so the crowds of hero-worshippers, looking on the mighty stage of human history, greet the actors, the historic elect, as if the elect, of their own will and deed, were the powers, and as if the concealed and inscrutable energy which governs and directs everything did not exist.



BENJAMIN RUSH

At the foundation of the great Republic of America, one of the conspicuous actors was the Æsculapian scholar, Benjamin Rush, of Philadelphia. This man his admiring contemporaries—and they were many—designated the Hippocrates of Pennsylvania. Hero-worship with a vengeance!

But Rush was, nevertheless, a great as well as a conspicuous character, worthy of his time, and one of the elect of history. Our Isaac Lettsom, less enthusiastic and more precise than the native worshippers, styled him the American Sydenham, a title which holds fast. "Rush," says Lettsom, "approached, if not exceeded, Sydenham in grandeur and compass of thought, though less discriminating in that felicitous arrangement of medical phenomena which distinguishes Sydenham, whilst his theories were less consonant with nature. To Sydenham the motto *conamen naturæ* is most applicable; to Rush, *nullius in verba*. To this opinion the illustrious Dr. Thomas Young has added respecting the American Sydenham:—"His accurate observations and correct discrimination of epidemic diseases well entitled him to this distinction, while in the original energy of his character he far excelled his prototype."

Rush was of English family. One of his ancestors, a Commonwealth man, was a favourite captain under the Lord Protector. William Cobbett, alias Peter Porcupine, in a satirical work he wrote on Rush, under the absurd title of the "Rushlight," a work I shall have to refer to in a future page, made a paltry attempt to run down Rush by proclaiming that John Rush, his father, "honest John," was of English extraction, and by calling a blacksmith, and that his mother, a very kind and pious Presbyterian, "kept a huckster's shop or stall, and, recollecting the apostle's remark respecting the salubrity of wine for the stomach's sake, occasionally administered to the comfort of her fellow-creatures by retailing drams." Cobbett, there is no doubt, wrote this under feelings of bitterest irritation, but it was unworthy of him in every way. It was no disparagement to Rush if what he said were true; but it does not seem to have even the merit of truth, for the other biographers state that the father of Benjamin Rush was a farmer, and that he, Benjamin, was born on his father's farm in Byberry township, near Philadelphia, Pennsylvania, on December 24th, 1745.

Benjamin Rush studied, in his first days, at the College of New Jersey, and in 1760 took his preliminary degree in arts. He next, for six years, pursued his medical studies as a pupil of Dr. Redman of Philadelphia, and thus prepared, after the excellent custom of those days, for entry on a course of systematic collegiate study in medicine, he proceeded to Edinburgh University, then in its rising glory as a medical school. Here the young American lived and worked for two years, and in 1768, being now twenty-three years old, took his Doctor's degree in medicine. His thesis, which was published in 1786, and of which there is a copy in the library of the British Museum, entitled "*Dissertatio de coctione ciborum in ventriculo*," was greatly esteemed, and seems to have given him a good name as an original thinker from the very outset of his career. From Edinburgh he proceeded to London for further study, and from London to Paris, passing the winter of 1768 and the summer of 1769 in the medical schools of those cities.

Returning to Philadelphia in 1769, Rush was elected to the Chair of Chemistry in the College of Philadelphia, and continued in that office until 1789, when he took the Chair of the Theory and Practice of Medicine, which he held for two years. In 1791, the Philadelphia College was raised to the rank of a University of Pennsylvania,—and with that change the Professor of Theory and Practice of Medicine was appointed Professor of the Institutes and Practice of Medicine and Clinical Professor; and, in 1796, of the Practice of Physic proper. In these offices he remained actively engaged up to the period of his death in 1813.

Throughout the whole of his career Dr. Rush was always the physician. His heart, his soul, his strength, were wholly devoted to professional work and professional welfare. In his early days he was so absorbed in his studies and in his practice that the pleasures of domestic life were held in abeyance. He declined to marry until he felt that the cost of his medical researches would not be trespassed on by home necessities. Twitted on this subject by an old friend, Dr. Ramsay, he wrote in reply:—"Medicine is my wife; science is my mistress; books are my companions; my study is my grave."

At last, even this stern student was compelled to submit to gentler fate, and in 1777 he married Miss Stockton, daughter of Richard Stockton, of New Jersey, one of the successful rebels against Great Britain. The marriage seems to have been in every way suitable, happy, and in no way injurious to the work of the enthusiast, who so sorely dreaded the result of family responsibilities.

The success of Dr. Rush as a physician in his native city appears to have been safe from the first, and he devoted his energies so earnestly to its cultivation that he ever steadfastly maintained it. At the same time he was no slave to mere practice. Possessing a brain as resolute as it was active and powerful, he permitted himself to be a politician, a man of letters, a scholar, and a philanthropist. He was declared, by one who knew him best, to have been a public writer for a period of forty-five years, and few social, political, or scientific subjects escaped his comment or criticism. To him, says Ramsay, "every place was a school, every person with whom he spoke a tutor." He kept a note book which consisted of two parts. In one part he entered facts as they occurred under his observation; in the other part he entered ideas and observations as they arose in his own mind, or were suggested by others in the course of conversation. He possessed also the very useful faculty of reading or writing with the utmost composure in the midst of the noise of children, the conversation of his family, and the commonplace interrogatories of his visiting patients. In this facility he resembled Joseph Priestley, who wrote many of his most learned essays and works by his fireside, with his family and friends around him.

The trying political events by which he was, for a time, encompassed, engrossed, as was natural, much of the attention of our American Sydenham. Like his prototype, he was a man whose sympathies were with the people and the liberties they fought for. He was amongst those who, in 1776, drew up the declaration of independence, and his name appears, with that of his wife's father, Richard Stockton, as one of the most distinct on that famous document. He took, moreover, an active part in the military work by which the victory of independence was won. In the early part of 1777 he was made Surgeon-General, and in the summer of that year Physician-General of the military hospitals for the Middle Department of the States. In this capacity he gave his skilled attention to his wounded compatriots of the battles of Princetown and Brandywine. For these and for his general services to the cause of independence he was elected a member of the Convention of Pennsylvania for the adoption of the Federal Constitution, and, in 1799, was made Treasurer of the United States Mint, a post which he held for the remainder of his life. His political opinions were in some respects chequered. In respect to the great demonstration, the institution of independence, and the establishment of the Republic of the United States, he was always of the same mind. In that he gloried. But he differed with many of his compeers, and even with the illustrious chief Washington himself, on various social-political problems. Thus he was amongst the first to raise his voice against the institution of slavery, and to indicate what danger to the future integrity of the United States was concealed in that dark shadow. He was opposed also to the punishment of death for reasons as soundly thought out as they were eloquently expressed. In his later days, Rush tempered the fire of his energy by a system of Christian discipline which might be called primitive in its expression. "I have been alternately called," he wrote, "an aristocrat and a democrat; I am now neither. I am a Christocrat."

In this spirit he defended Republicanism. "A Christian," he urged, "could not fail to be a Republican, for every precept of the Gospel inculcates those degrees of humility, self-denial, and brotherly kindness, which are directly opposed to the pride of monarchy and the pageantry of a court."

The public utterances of Rush becoming numerous, they were brought out in 1798 in a volume, under the title of "Essays, Literary, Moral, and Philosophical," and were dedicated, as a record of fraternal affection, to his brother, Jacob Rush, Judge of the Third District of Pennsylvania. It would be difficult to determine which amongst the many essays making up this curious and rich volume is the most advanced and most useful. Let me, as briefly indicating the prescience of the man, select a thought or two from a few of them.

Education of Women.

In an essay on the education of women, Rush leads the way boldly and uncompromisingly for the fullest and freest and highest education. "Let the ladies of a country be educated properly, and they will not only make and administer its laws, but form its manners and character. It would require a lively imagination to describe or even to comprehend the happiness of a country where knowledge and virtue were generally diffused among the female sex." From this, as a preamble, he sets forth what might happen in America if, as a new country starting on her new foundations, she were to bring up her daughters with the same educational advantages as her sons. He hopes she may, but he is not enthusiastic. In the course of human affairs, America, he fears, will too soon follow the footsteps of the nations of Europe in manners and vices, and that the first marks of declension will appear amongst the women.

On Oaths.

In another essay he objects to the ceremony of taking oaths. To this ceremony there are, he inculcates, two sets of objections—one founded on reason, the other on the precepts and the spirit of the Christian religion. In respect to the reason, he argues that oaths are harmful, because they produce in the minds of men an idea that there are two kinds or degrees of truth—the one intended for common, and the other for solemn occasions; an idea directly calculated to beget a want of reverence for the inferior kind of truth, by which men are led to trifle with it in the common affairs of life. It is true that some men will tell the truth when urged to it by the solemn formalities of an oath; but this proves the great mischief of oaths in society; for as men are called upon to speak the truth nine hundred and ninety-nine times in common life to one time when they are called upon to swear to it, the truth is imperilled the same as if there were two kinds of it. There is a scale of falsehood, but truth has no degrees, no sub-divisions. Like its divine Author, it is an external and unchangeable unit. Again, the taking of the oath is an instance of the bases of profane swearing, because if there are two modes of speaking the truth, it is natural for men to prefer that mode which the laws of the country have entitled to the first degree of credibility; hence men swear when they wish to be believed in common conversation.

Public Punishments.

In another essay he exposes the injurious influence on the mind of public punishments. Against such scenes he argues on various grounds. They cannot reform a criminal, because, as the punishment is always connected with infamy, it destroys in him the sense of shame, which is one of the strongest outposts of virtue; and experience proves that public punishments have multiplied the propensities to crime. Moreover, public punishments, so far from preventing crimes by the terror they excite in the minds of spectators, are directly calculated to produce crimes; for all men when they suffer discover either fortitude, insensibility, or distress. But fortitude is a virtue and is admired. "I call upon you," said Major André, at the place of execution, "to bear witness, gentlemen, that I die like a brave man." The effect of this speech on the American army is well known. "The spy was lost in the hero, and indignation everywhere gave way to admiration and praise." Insensibility removes instead of exciting terror. Distress of all kinds, when *seen*, produces sympathy, a disposition to give relief, and palliation even to crime.

Inconsistency of Punishment of Murder by Death.

Rush was amongst the first of philanthropists to oppose capital murder, or committal of murder by the State for the purpose of setting example to individuals not to commit murder. His reasons for opposing capital murder are well founded. It lessens the horror of taking away human life. It multiplies murder from the difficulty it creates of convicting persons who are guilty of it. It checks the operations of universal justice by preventing the punishment of every species of murder. Respecting murderers Rush expressed that there are many crimes which unfit a man for human society more than a single murder, which may have been the effect of a sudden gust of passion, and has sometimes been the only stain of a well-spent or inoffensive life. He also maintains that there have been instances of murderers who have escaped conviction, and have afterwards become peaceable and useful members of society. "Let it not be supposed," he adds, impressively, "that I wish to palliate by this remark the enormity of murder. Far from it. It is only because I view murder with such superlative horror, that I wish to deprive our laws of the power of perpetrating and encouraging it."

Plan of a Peace Office.

Amongst the other original projects of Dr. Rush was one for the establishment of a peace office for the United States. He proposed that there should be a great state officer, who should be the Secretary of State for Peace. This officer should have control over all the free schools in every city, village, and township in the States. His efforts and influences were to extend to many details of common life, but his great work would be to subdue that passion for war which education, added to human depravity, has made universal, by familiarity with the instruments of death, and by great military shows. Through his influence militia laws should everywhere be repealed, and military dresses and military titles should be laid aside, as well as military reviews, which tend to lessen the horrors of a battle by connecting them with the charms of order. Through the same influence military dresses and titles, which fascinate the minds of young men, and lead them from serious and useful professions, should be discarded, because, were there no *uniforms* and no *military titles*, there would probably be no armies, and no titles to feed vanity and keep up ideas in the mind which lessen a sense of the follies and miseries of war.

A Paradise of Slaves.

A remarkable little paper, under the title, "A Paradise of Slaves," describes a dream that Rush had, in which he felt himself transported to some new world, where slaves were enjoying an eternal blessedness. The life history on earth of some of these is given from their lips, and as the narratives were, obviously, founded on the real histories of some wretches who had fallen under the blows or cruelties of their masters, the narrative, dream as it was, went home with no trifling effect. In a more connected and artistic way Mrs. Beecher Stowe raised a fire of sympathy, which shone the world through, by her "Uncle Tom's Cabin." But the first spark of that fire was kindled by Benjamin Rush, and the spark was never extinguished. It hung like the lamps in the temples, keeping alive the souls of men to the supreme iniquity it exposed, until, though not without awful bloodshed, the iniquity was abolished for ever.

The Influence of Physical Causes on the Moral Faculties.

In a splendid oration on this subject Rush defines the moral faculty as a power in the human mind of distinguishing and choosing good and evil. "It is a native principle, and though it is capable of improvement by experience and reflection it is not derived from either." He considers that Paul and Cicero give the best definition of the moral faculty—Paul in Romans ii. 14, 15, Cicero in the far-famed "Oratio pro Milone,"*— and he is careful to distinguish between it and conscience. "The moral faculty is what the schoolmen call the *regula regulans* — conscience is their *regula regulata*. The moral faculty performs the office of a law-giver, the conscience of a judge. "The moral faculty is to the conscience what taste is to the judgment, and sensation to perception." The total absence of the moral faculty he styles ANOMIA, the weakened action of it MICRONOMIA. Thence he studies the influence upon it of various physical causes, climate, diet, certain drinks, excessive sleep, bodily pain, cleanliness, solitude, silence, music, eloquence of the pulpit, odours of various kinds, light and darkness, medicines, imitation, habit, association, sensibility, cruelty, attraction, composition, decomposition, each of which influence is itself made a subject of study. The oration—delivered at the invitation of the Philosophical Society of Philadelphia before the President of the State, the Supreme Council, and the members of the General Assembly of Pennsylvania—closes with a glowing tribute to Benjamin Franklin, a man "who appears to have been lent to mortals on purpose to render our globe a more convenient and safe habitation for the children of men."

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* "Est igitur hæc, judices, non scripta, sed nata lex, quam non didicimus, accepimus, legimus, verum ex natura ipsa arripuimus, hausimus, expressimus, ad quam non docti, sed facti; non instituti, sed imbuti fumus."

On Mode of Education.

On the education of youth, Dr. Rush held a view which, in its day, was considered to be singular in the extremest degree. An eminent scholar and philosopher, David Rittenhouse, had said to him, "I once thought health the greatest blessing in the world, but I do not think so now. There is one thing of much greater use, and that is time." To me this saying does not seem to be of much weight, inasmuch as time without health is a burthen, but it impressed Rush with the idea that to save time was a matter of primary moment for the young. He, therefore, suggested that five years spent in learning the dead languages, to the exclusion of other branches of learning more directly practical, was an ancient mistake. He did not wish the knowledge of the Latin and Greek languages to be extinct in the world. Far from it. His wish was to see such knowledge preserved, like the knowledge of law or medicine, by a distinct profession, devoted to the study of those languages. His arguments in favour of this change were that it would perfect the English language by checking the increase of derived superfluous words; that it would quicken the advance of science by dismissing the fetters of ancient words; that it would destroy the prejudices of the common people against schools and colleges in which the pupils are taught to call a horse or a cow by two or three different names, while they are taught nothing as to the qualities and uses of these valuable animals; that it would be a means of banishing pride from the seminaries of public education, men generally being most proud of those things that do not contribute to the happiness of themselves and of others; that it would increase the number of students in the colleges; and, that it would remove the present immense disparity which subsists between the sexes in the degrees of their education and their knowledge.

Such are a few of the general lessons taught by our versatile scholar. If I had a volume to dispose of instead of a few poor pages I could fill it with his thoughts. As it is, I have ventured to make a selection in the briefest form, that, at least, the reader may taste their quality, and form some idea of the excellency of the whole from the spirit of one or two of the distinctive parts.

In a sentence, Benjamin Rush, more than a century in advance of his time, led the way to reforms, some of which, fully accomplished, have been amongst the most beneficent ever bequeathed from man to man. His greatest idea, the Court of Peace, remains still in the future, but that it, too, is coming, is clear to all who have eyes to see that military glory is day by day receding; that uniforms are sinking into liveries; and that they who are the most successful leaders in the field of war are but ordinary men when they return to the paths of peace.

RUSH AS A PHYSICIAN.

The unfriendly Porcupine, William Cobbett, depicts Rush as riding out to see his patients "in a queer-looking hutch, big enough to hold only one man." "It has a glass door and windows; it is drawn by one horse, and has an elevated box, from which a negro-fellow lashes his poor four-legged fellow-citizen."

To such keen caricature Rush was not insensible, but he bore up bravely against it, and although, according to our modern views, he may have been in error in one direction of practice, blood-letting, the error, conscientiously carried out to a degree almost without a parallel, did not spring from himself. It was a part of his education, and had its virtues as well as its vices.

In his character of Physician we may look upon Rush as a Healer, a Sanitarian, an Orator, a Man of Letters, and a Teacher. Within the strict lines of the accomplished Physician, he was remarkably conspicuous in all these departments.

Six volumes of medical inquiries and observations; a letter to Lettsom on the cause and cure of tetanus; a paper on a new method of inoculating for the smallpox; a letter to Dr. Miller on the spasmodic asthma of children; on the effects of spirituous liquors on the human body; and various other observations of a practical kind, indicate that, as a representative of the curative school of medicine, Rush was one of the best informed and advanced physicians of the eighteenth century. His reputation as such has, however, from peculiar circumstances been made to rest too exclusively on his work published in 1794, on "The Bilious Remitting Yellow Fever, as it appeared in the City of Philadelphia in the year 1793.

It was for the position he took during this great epidemic that Rush came under the lash of William Cobbett,—then living in Philadelphia, and editing, under the name of Peter Porcupine, the *Porcupine Gazette*,—a lash so severe that the physician brought an action against the editor, gained a verdict of five thousand dollars, and therewith an enemy more implacable, keen, and violent, than perchance any other son of Æsculapius ever encountered.

In the treatment of the fever Rush adopted the system of the freest blood-letting, combined with mercurial purges. On the merits of this system, or the demerits, Cobbett founded his attacks, and, as the judge expressed at the trial, was as merciless on the man as on the system. Rush in practice followed the French Botallus. Botallus was the bleeder whom Le Sage had characterized under the name of Sangrado; hence to Rush, Cobbett applied the name of the Sangrado of America. Sangrado was looked upon in Valladolid as another Hippocrates, therefore Rush was known by the name of the Hippocrates of Pennsylvania. These were only a few of the bitter tauntings of the fierce English satirist, whose hand, up to the close of his life in our own country, in 1835, never lost its cunning; whose vigour was such that he left behind him a hundred political volumes; and whose hate was so intense that he used as a motto, from Swift, "If even a flea bite me I will kill him."

I have read through all the storm of Cobbett and the defence of Rush. I wish I could put my pen through both. Very little that Cobbett said and wrote is more than mere rashness and fury. Very much that Rush did had, perchance, better been left undone, for his own history of the bleedings he carried out makes us start, in these days. From Mr. Peter Mierken he drew one hundred and fourteen ounces of blood in five days. From Miss Bridges, in the ninth year of her age, he drew thirty ounces of blood in five bleedings, and so on and on. His justification of the practice was that his patients recovered when the bleedings were most copious. Yes, responded the *Porcupine*, but his sister and pupils died in his own house, blood-letting nevertheless.

Whoever wants to read a wonderful book will still read Rush, "On the Bilious Remitting Yellow Fever." The copy before me, and which I have just read through, had not one leaf in it cut until my paper-knife visited it. It had lain ninety years in its original sin, as Porcupine would have declared; but, surely, a more interesting reading was never secured at so little trouble. It has been the carriage book for a week, and has never tired. There is a final chapter in which a description is given of Rush's own sensations during the period of the epidemic. It is as if he were talking to you, a ghostly whispering, through a veil of nine-tenths of a century.

As a Sanitarian Rush shines cloudless altogether. Few physicians, indeed, have, in any age, been more advanced in sanitation than he. Fresh air, cleanliness of body and mind, temperance, industry, active purity all life through, were his watchwords. Debility, from idleness and sloth, he never ceases to expose and condemn. "The clown who supposes the crooked appearance of a stick when thrust into a pail of water to be real, does not err more against the laws of light than that physician who mistakes the debility which arises from oppression for an exhausted state of the system, and attempts to relieve it by stimulating medicines."

Of intemperance he saw almost all the evils, and never tired in raising his voice against it. He calculated that in the United States, in his day, four thousand persons died annually from intemperance—an estimate not far out of proportion with what, despite his warning voice, occurs there and here at the present time. He told the intemperate to abstain, not drop by drop, but "suddenly, entirely." "Taste not, handle not, touch not." He showed the stages of the disease of drunkenness in eleven figures of expression, quite worthy of re-publication. And to his professional brethren he wrote: "Give as few medicines as possible in tinctures made with distilled spirits. Perhaps there are few cases in which it is safe to exhibit medicines prepared in spirits in any other form than drops. Many persons have been innocently seduced into a love of strong drink from taking large or frequent doses of bitters infused in spirits. Let not our profession be reproached in a single instance with adding to the calamities that have been entailed upon mankind by this dreadful species of intemperance." Finally, to support all he had said on this topic, he, with more care and precision than any previous medical observer, defined the physical and mental diseases which take their distinct origin from the alcoholic destroyer.

Against the use of tobacco he was equally explicit, and in his condemnation of snuff-taking was unsparing. He calculated that a confirmed snuffer lost five days' time out of every year in the mere act of lifting the snuff from his box and drawing it into his nose.

As an Orator Rush makes a distinguished figure. His orations on the famous Dr. Cullen, of Edinburgh, once his honoured master, and on his friend David Rittenhouse, are models of eloquence in reason and sentiment. I quote one passage from the eulogy on Cullen as an example. It is a golden utterance.

"That physician has lived to little purpose who does not leave his profession in a more improved state than that in which he found it. Let us remember that our obligations to add something to the capital of medical knowledge are equally binding with our obligations to practise the virtues of integrity and humanity in our intercourse with our patients. Let no useful fact, therefore, however inconsiderable it may appear, be kept back from the public eye; for there are mites in science, as well as in charity, and the remote consequences of both are often alike important and beneficial. Facts are the morality of medicine; they are the same in all countries, and throughout all time."

As a Man of Letters, Rush deserves the highest praise. His style, always clear, concise, straight, is often rich, poetical, eloquent. He is so attentive to his own precept on the value of facts, that he drops, incidentally, as trifling observations, what smaller men would bring forth as the treasures of their minds. Thus in reading him the student is ever gathering side views which illustrate time and history without for a moment loosening the thread or the full force of the argument. We learn, to take a single instance of this kind, in the essay on the Bilious Remittent Fever, that children inoculated for the small pox sometimes died from erysipelas, commencing at the seat of the punctures,—a fact indicating that inoculation, like vaccination, had its primary dangers.

His facility as a writer was equalled only by his industry, his facility and industry only by his versatility. To Sir John Sinclair's "Code of Health and Longevity" he added a commentary on the state of the body and mind in old age. To Botany he contributed a paper on the Sugar Maple Tree. Not content with his own writings, he edited those of Sydenham, Sir John Pringle's "Diseases of the Army," and the works of several other authors of lesser distinction. He also wrote an account of Christopher Ludwick, Baker-General of the Army during the Revolutionary War.

As a Teacher he was considered unequalled in his time and country. He had under his tuition over two thousand three hundred pupils, and he published no fewer than sixteen anniversary addresses on medicine. He contended that composition and speaking are the same art, and that men who commence to compose in early life never repeat themselves, as less trained men do, in extemporary exposition.

Dr. Rush continued, in his life of activity, sleeping little, working much, until April 19th, 1813, when he died, somewhat suddenly, in perfect peace, and in the midst of such universal sorrow, that as he lay in death crowds of the poor of his city besieged the house praying to be permitted to see his face once more, or even to touch his coffin when that was closed.

One fine day in the past glorious summer, wandering through Greenwich Park with two men of kindred genius, each in his way choice companionship, Weir Mitchell, of Philadelphia, and Thomas Woolner, our great English sculptor,—Woolner vivacious as the glinting light through the foliage, and Mitchell dreamy as the shades,—I touched the Philadelphian into energy by asking him without premise :—

"Do you know anything of Benjamin Rush ?"

"Just a little," replied he. "Why do you ask about him ?"

"I want him for an ASCLEPIAD."

"I'll get you his portrait and some books relating to him."

"Who was Rush ?" inquires Woolner.

"One whom you might sculp for Philadelphia, my dear R.A., but Mitchell will tell you more of him than I."

And Mitchell responded so brightly, I would I could remember all he told. Suffice it that from the stimulus of his narrative, and a generous loan of books by my friend Henry Stevens, F.S.A., of Vermont, I have done my best to call up, for a moment, one of the most original and powerful men whom medicine has ever claimed for a son.

To compare Benjamin Rush with Hippocrates is fair to neither; and although, after Lettsom and Young, I have called him the American Sydenham, that is scarcely fair.

Benjamin Rush was the first great American physician *sui generis*.

OPUSCULA PRACTICA:

USEFUL NOTES FOR BUSY PRACTITIONERS.

> "There are mites in science as well as in charity."
>
> BENJAMIN RUSH.

DEATH FROM METHYLENE.

A DEATH from methylene in the hospital at Plymouth a few weeks ago has led to some discussion in *The Lancet.* I was at the hospital the day after the sad event, and learned from Dr. E. Square and Dr. Buchan the particulars. The patient had taken the same anæsthetic once before without any unpleasant symptoms. On the fatal occasion he was rendered almost tetanic in the second degree of narcotism, and ceased to breathe while in that degree. There was no sufficient organic lesion to account for death, and I am forced to ascribe the death to the special action of the chloride on the minute circulation,—to general spasm, affecting specially the terminals of the arterial pulmonary circuit. Dr. Buchan was good enough to give me a specimen of the anæsthetic fluid from the same bottle as that which supplied what had been inhaled by the patient; and as the fluid had been manufactured by Messrs. Robbins, I visited their laboratory and witnessed the method they follow. The method is the same as I described in my original paper, in introducing methylene bichloride as an anæsthetic, and is according to the directions usually given by the chemical authorities. Into a retort chloroform is added to pure zinc with a little absolute alcohol. In a short time a brisk action is set up, the zinc is freely acted upon, and a fluid is distilled over at an equal temperature of 128° Fahr. When the distillation ceases at that temperature the fluid is removed, and is again subjected to the zinc. The result is a fluid, the boiling point of which, as taken by the uniform point of distillation, is 128°, and the specific gravity of which is 1320, compound with water at 1000. The product has, consequently, a boiling point 14° Fahr. under chloroform,—the boiling point of chloroform being 142° Fahr.,—and a specific gravity of 160° under chloroform—the weight of which is 1·480, taking water at 1000 as the standard. The vapour of the fluid also burns with a blue flame, in this respect differing from the vapour of chloroform, which extinguishes flame. After the removal of the fluid from the retort in which the zinc has been, the zinc is found to have been acted upon in the freest manner, zinc chloride and oxide having resulted—the chlorine derived from the chloroform, and the oxygen from the alcohol. Whatever care may be taken in the distillation, a little chloroform, a little alcohol, and a slight quantity of water—produced during the action—will pass over, a circumstance which has given rise to the hasty statement that the fluid called, shortly, "methylene" is an admixture of alcohol and chloroform. It is really a fluid in which the chloroform has been reduced, but from which, unfortunately, the whole of the chloroform has not been removed. If those who criticise this misfortune would discover a means by which it could be removed I should be really grateful, the addition of the chloroform being a very distinct addition to the danger of the anæsthetic. Why this is the case I ought perhaps once more to explain. In some of these anæsthetics of the chlorine series the radical methyl, CH_3, is the cause of the anæsthesia, while the combining chlorine is the cause of the excitement and of the danger. Thus I found methyl chloride, CH_3Cl, much calmer in its action than methylene bichloride, CH_3Cl_2; and methylene calmer than chloroform CH_3Cl_3; and chloroform calmer than carbon tetrachloride, CCl_4, in which the carbon alone remains as the anæsthetic. Methylene bichloride being a liquid, I fixed upon it as more manageable than methyl chloride, and less dangerous than chloroform. As it is, it is less dangerous than chloroform, and if chloroform could be completely expunged from it it would be very safe. But there is the crux. The small addition of alcohol and of water can in no way add to the danger, and may be disregarded. The chloroform is the diabolus.

The best method with which I am conversant for preventing the spasmodic stage induced by the methyl chlorides is to administer to the patient, by the mouth, twenty minutes before the inhalation—not brandy, nor any uncertain mixture of that sort, but from four to six fluid drachms of absolute alcohol with eight ounces of warm water. When the alcohol is beginning to quicken the pulse and to make the surface of the body glow, the chloroform or methylene inhalation may begin. I always prescribe alcohol in this way when about to administer any one of the methyl chlorine series, and have rarely witnessed a serious spasmodic second degree of narcotism since I commenced the practice. See ASCLEPIAD, Vol. I., pp. 159-61. The period required for complete narcotization is also, I think, lessened by the pre-administration of the alcohol.

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ETHYL AND METHYL BROMIDES.

IN 1867-8 I made some researches with bromide of methyl, CH_3Br, a gas formed by mixing at a low temperature fifty parts of bromine, two hundred of methylic alcohol, and seven of phosphorus. Under cold the ether can be distilled over as a fluid, but it boils at 55° Fahr., and is therefore at ordinary temperature a gas. Its vapour density is 48. Bromide of methyl is an anæsthetic equally effective as bromide of ethyl, and sharing in all its faults.

There is another point in which the bromides of ethyl and methyl may be considered, and which is of direct practical worth. They are both powerful deodorizers and destructives of decomposing organic matter; and as they are, from their volatility, capable of being conveyed in a state of fine subdivision, they might be employed with advantage in many forms of disease. In phagedenic or malignant ulceration of the throat or skin, in cases where a cavity in the lung contains offensive secretion, and in uterine affections where there is accumulation of decomposing fluid, the hydrobromic ether, as the most manageable, might well be brought into action. It could be inhaled when the throat or lungs were the seats of disease; it could be allowed simply to diffuse from cotton-wool over open surfaces or into the uterine cavity.

METHYL IODIDE.

IN 1867-8 I made a careful study of Methyl Iodide, and reported on it to the British Association at Dundee and Norwich. I found it to be an anæsthetic and powerful sedative. I found that a grain could be taken diluted in alcohol with safety for a dose, and in a case of syphilitic ulceration obtained the most rapid curative result. In 1867-8 I got my friend Mr. Nunn to use methyl iodide, in four cases of cancer in the cancer wards of the Middlesex Hospital. The medicine was administered internally in an alcoholic solution made by Messrs. Robbins, of Oxford Street. In one of these cases, where extreme hyperæsthesia of the whole surface of the chest had followed an operation performed a year before, complete relief was obtained from the iodide when other means had failed. In the second case—one of uterine cancer—there was great relief to pain. In the third instance, one of recurrent cancer, the good effects were less apparent; but in the fourth, an open ulcer on the breast, cicatrization occurred under the iodide, and the patient left the hospital with the ulcer quite healed. Some time afterwards, however, there was return of deposit. On the whole, the results in relief of pain were very remarkable, and I blame myself much for not following them up. To remedy the omission, I write this brief notice, in the hope that other practitioners may be led to continue the research. The alcoholic solution of methyl-iodide for internal use is made by adding six grains of the iodide to sixty minims of absolute alcohol. The dose is ten minims in a wineglassful of cold water. It is agreeable to take.

USES OF A COMMON PARAFFIN TAPER.

A COMMON white paraffin taper makes, I find, one of the best bougies for exploring the nasal cavity. I use a taper of from one-eighth to one-sixth of an inch in diameter, and about ten inches in length. For mere exploration I round off the end that is to be introduced into the nasal cavity, bend the taper into an easy curve, make it slightly soft by warming it in my hand, and then have it ready for use. The perfect smoothness of the surface of the bougie thus formed, the ease with which it bends, and the just sufficient strength given to it by the wick, are qualities which make this simple, inexpensive, and always ready instrument very effective. From its colour it is also readily discernible in the throat when it is passed into the pharynx.

The taper has other uses. If it be wished to apply iodine evenly to the whole of the nasal cavity, the thing can be done at once by means of the taper. It is merely necessary to paint the end of the taper for a couple of inches with iodized colloid, or with tincture of iodine, and then introduce it, to secure that all the iodine is left on the mucous lining of the nasal cavity. In ozena patients can be taught to carry out this method for themselves at stated times. I have two patients now who have done this with the best effect.

The taper admits of another useful application. If the cotton within it be nicely teased out at one end of a short length, the cotton makes one of the most convenient of brushes for applying iodine or other solutions to the throat. In scarlet fever and other affections attended with throat complication, I invariably instruct the nurse or attendant to be provided with a few tapers of different sizes, and to make them act as the brush for applications to the throat; and so soon as one brush has been used, to cut it off with scissors, burn it, and make another. The same kind of brush can be used with equal advantage for cleaning the tube after the operation of tracheotomy.

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CARBON BISULPHIDE AS ANANTISEPTIC.

IN my Cantor Lectures on putrefactive changes, delivered before the Society of Arts in 1878, I described in the second lecture of the course the antiseptic properties of bisulphide of carbon.* As this subject is now being discussed, I may venture to repeat so much of the lecture as to say that in the research, which was there described, I found the bisulphide to be an excellent antiseptic for the preservation of animal structures, but not for their colour. The bisulphide preserves and bleaches. I showed a specimen of muscle in bisulphide vapour in common air, which had been well-preserved for forty-five days, but was quite colourless.

On the whole, I found that this vapour does not preserve better than chloroform or ammonia, is more difficult to retain owing to its volatility, and, from the peculiarity of its odour, is more objectionable in the sick-room, and even in the laboratory. How far it is useful in medical and surgical practice, as an antiseptic, I must reserve for a future and more elaborate description.

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* "Some Original Researches on Putrefactive Changes, and on the Preservation of Animal Substances." Lecture delivered on April 15th, 1878.—*Journal of the Society of Arts*, April 1878.

FURTHER RESEARCHES ON EUTHANASIA FOR THE LOWER CREATION.

UNDER the title "Euthanasia for the Lower Creation," I described in general terms, in The Asclepiad for July 1884, No. III., pp. 260—75, the successful attempt I had then made for the painless extinction of life in the lower animals. Following up the research, I was prepared on Tuesday, December 16th, 1884, to deliver a lecture on the subject, with diagrams, models, and full details, before the Society of Arts, at their rooms, John Street, Adelphi; my old and revered friend, Edwin Chadwick, C.B., in the chair.

In a few succeeding pages, I now offer to the readers of The Asclepiad, from that lecture, such new facts and details as will make the former paper more complete, supplying also, by diagram, the information, at present much sought after, for enabling other persons to construct and carry out the lethal process.

I may premise that since the process has been in use at the Dogs' Home, Battersea, nearly seven thousand dogs have been painlessly killed by it. It has also worked so well practically, that no untoward accident or result has occurred in the seven months in which it has been in operation.

In the details here supplied, I shall describe :—(*a*) The anæsthetics; (*b*) The chamber; (*c*) The modes of procedure. I shall also add a brief account of a small and portable lethal apparatus, intended for use in towns and villages through the country generally.

THE ANÆSTHETICS.

The anæsthetics I have used for the lethal death are four in number :—Carbonic oxide, chloroform, carbon bisulphide, and common coal gas.

Carbonic Oxide.—I was led to carbonic oxide, not only by reading of it, and by witnessing the effects of it as a poison when it has been breathed from coke fumes, but specially from studying its action when evolved from the fumes of the *Lycoperdon giganteum*, or common puff-ball. The fumes as thus evolved have been employed for centuries past by the common people for narcotising bees before taking the honey from the hive. A portion of the substance being burned under the hive, the bees, inhaling the fumes, fall into a deep sleep, during which time they are unconsciously deprived of their industrious earnings. I was so struck with the perfect action of these fumes, after being shown one of these experiments, that, in 1854, I introduced the fumes for anæsthetic purposes. Purified by being passed through water, they produced the most rapid narcotism, under which many operations were performed painlessly on the inferior animals. The late Dr. John Snow, so well known for his immense labours on anæsthetics, and the late Mr. Thornton Herepath, one of our most promising chemists, each separately engaged in discovering the concealed gas or vapour. They, simultaneously, but by different methods of research, arrived at the fact that the narcotic present was carbonic oxide, or the same gas as is produced during the combustion of carbon or coke in a limited supply of oxygen.

These researches led me to study the action of carbonic oxide in its pure form, and to the discovery of many curious facts relating to it. Amongst other things, I noticed that, like oxygen, it made the venous blood of a bright red colour, and that warm-blooded animals exposed to it for a long period in limited quantities are rendered temporarily diabetic.

I did not, on the whole, think it commendably safe as an anæsthetic for man, but I fixed upon it at once as one of the best and cheapest of lethal agents for the painless destruction of life in the lower creation. It is the principal agent for this purpose which I have used since the date named above, 1854.

Carbonic oxide is a gas, and if quite pure is so odourless and produces so little irritation, that when present in the air, it is apt to be breathed unconsciously until the effects of it are felt. Those who by accident have been narcotised by it, and have recovered from the effects, have expressed that they had no recollection of anything whatever, that they passed into sleep in the ordinary way of sleeping, and knew no more.

The gas can be made in two easy ways:—

(1) It can be made simply by passing air or oxygen over burning coke or charcoal. If air be used, the product consists of carbonic oxide, with some carbonic acid, and with the nitrogen of the air, which passes through the furnace unchanged. As the nitrogen forms four-fifths of the air, the carbonic oxide is very much diluted. A hundred cubic feet of an atmosphere so produced contains no more than fifteen per cent. of the gas. Such an atmosphere is, nevertheless, very deadly, because the nitrogen, being entirely negative, has no

power of sustaining life. When oxygen is used alone in limited quantity the gas is turned out practically pure. By either mode—by common air or oxygen—one pound of charcoal should yield thirty-one cubic feet of the lethal gas, assuming that the combustion is correctly carried out.

(2) The second mode of making the gas is by passing carbonic anhydride, still commonly called carbonic acid, over red-hot charcoal. The charcoal in this instance is placed in a tube, into which the carbonic acid, CO^2, can flow. The tube is put into a furnace, the charcoal is made red-hot, and while in this state the carbonic acid passes over it. The carbonic acid is thus deprived of one part of its oxygen by combination of oxygen with the heated carbon, and carbonic oxide escapes at the exit of the tube. The gas thus formed is practically pure, and is very deadly. If even a little carbonic acid does pass over in its free state, the lethal action is sustained, carbonic acid being itself a gas destructive to life.

Chloroform.—I was naturally led to chloroform by reason of its common use as an anæsthetic. There is no anæsthetic more certain in its action, and none more certain to kill if it be administered in a determinate manner. Administered even with skill, so as not to kill, it proves accidentally fatal about once in two thousand five hundred times, and so soon as air is charged with over five per cent. of its vapour, it is not breathed without danger. Death from chloroform is very determinate when it occurs, and seems to be entirely painless.

The vapour of chloroform does not burn. On the contrary, it extinguishes flame. If we plunge a lighted taper into a jar through which the vapour of chloroform has been diffused, the light is at once extinguished. I shall show, in the sequel, that this has a certain useful bearing, apart from the matter of fatal narcotism.

Chloroform being purchaseable as a chemical fluid, I need not refer to its manufacture. When we use it for narcotism, we merely diffuse the fluid into the state of vapour, and make provision for the vapour to be absorbed by the lungs of those subjected to it. It produces little irritation when breathed.

Bisulphide of Carbon.—The bisulphide of carbon is a very rapidly-acting anæsthetic. It produces narcotism, in fact, almost as quickly as carbonic oxide, and with less muscular commotion. The vapour of it burns in air if a light be brought near to it, but when its vapour is mixed with that of chloroform this danger is avoided. It is bought as chloroform is, in the fluid state, and can be obtained, therefore, from the chemist directly, ready for use by diffusion of its vapour. It has one immense advantage, that of being excessively cheap; and it has one great disadvantage, that of being excessively unpleasant in regard to its odour, unless it be most carefully purified by repeated distillations. Combined with chloroform, with which it mixes freely, the peculiar odour is largely reduced, and by pouring the mixture over chloride of lime, is almost entirely removed. For this reason, together with that relating to the difficulty of combustion of the combined vapours, I have used largely in these researches a mixture of chloroform and carbon bisulphide. The combined vapours produce also a good antiseptic atmosphere. I have commonly used them for this purpose, and with much success.

Coal Gas.—Common coal gas is one of the most potent of narcotising gases. I pointed this fact out in the very early days of anæsthesia. The gas is a compound of four gases, three of which are excellent narcotics, and one a negative gas. It contains 47 per cent. of hydrogen, 42 of marsh gas, 3 of heavy hydrocarbons, and 8 of carbonic oxide. All these gases are anæsthetic; marsh gas is one of the best, and carbonic oxide the quickest; but they are all explosive.

For the lethal purpose, nothing could possibly surpass coal gas. I put it freely to the test, and found it answer all that we could desire. In an atmosphere containing 25 per cent. of this gas, an animal goes to sleep in from two to three minutes, and dies asleep as easily as in any narcotic vapour or gas whatever. The gas is always at hand, and for the present purpose is the cheapest and readiest of all. Used in the lethal chamber at Battersea, one hundred dogs could be put painlessly to death at the cost of a shilling, and without any more trouble than that of turning on and off the gas.

Under such circumstances, it seems absurd to think of going any further for a narcotic agent. And yet that is necessary, at all events when a large lethal chamber is wanted, on account of the danger from explosion. I feel so sure that an accident by explosion would occur from the frequent use of the gas in this manner, that I dare not undertake the responsibility of recommending it, except on a smaller scale, which has yet to be considered. A man smoking his pipe near the chamber, or carrying a light, or striking a match, might lead to the accident; or, the spark from the friction of the wheels of the cage with the tram beneath them, and on which the wheels rub, might cause the accident.

I hoped at one time that I had overcome this risk by the very simple expedient of letting the gas pass into a chamber through chloroform. The vapour of chloroform mixing with the gas would, I believe, prevent explosion, even if a flame were introduced. I therefore combined the gas with the chloroform, and found in the combination not only a splendid narcotic, but apparently a safe one in regard to explosion. I was disappointed. I narcotised an animal to death in a mixed atmosphere of coal gas and chloroform, and that both easily and safely. The chamber containing the animal was left for three hours, and at the close of that time the gas in it was not explosive, the vapour of the chloroform controlling the combustion. But the following morning, on striking a light in the chamber, the gas took fire with considerable force. During the cold night the vapour of chloroform had condensed, and left the gas free and explosive.

After this experience, I gave up the idea of using coal gas on a large scale. I think it may be useful in a small apparatus under some circumstances, but I would not, while admitting its many advantages, venture to recommend it as of general application.

All things considered, I was led to conclude that carbonic oxide was the best narcotic agent to employ, combining it with chloroform and carbon bisulphide if that should prove necessary. Deciding on this point, the next question was how to manufacture the carbonic oxide so as to bring it into practical use on the easiest as well as the largest scale.

I designed originally for the trial at Battersea to erect two large reservoirs, and to set up an apparatus for the generation of carbonic acid, with a furnace by which this gas could be transformed into carbonic oxide. By making the carbonic oxide in this way, and charging the gas-holders with it, it would be at hand at all times to be passed into the lethal chamber.

There were difficulties in the way of carrying out this design. The first of these were the expense and the skill required to work the apparatus. The reservoirs alone would have cost a hundred pounds, and when fixed would have taken up a great deal of room ; a skilled man would at the same time always be wanted to charge them and keep them in proper order.

These difficulties led me to keep to the original plan of a simply constructed stove, in which the gas should be made by burning charcoal. Here, however, when I got into experiment, I found several new difficulties which had to be removed.

The burning of charcoal in an ordinary stove produced sufficient of the gas, but the heat of the gas was such as to demand a means of cooling it before it should enter the chamber. There was also produced in the combustion so much vapour of water that the experimental small chamber with which I first manipulated was charged with steam, which condensing, left the walls of the chamber loaded with water, a condition most unfavourable to narcotic action, and destructive to the walls of the chamber itself.

While studying the best means of overcoming these objections, and after failing to overcome them by several methods, I luckily recalled Mr. Clark's condensing-stove. This stove is a most ingenious invention. The fumes proceeding from the combustion in the furnace first ascend and then descend through two lateral columns, to escape by a tube directed over a trough or saucer. A large quantity of water vapour is in this way condensed, and is collected at the base of the stove. To adapt the stove to my purpose, I got Mr. Clark to make a charcoal furnace over a gas-burner, so that when the charcoal was laid in the furnace it could be instantly set alight by merely turning on and lighting the gas, letting the flames of gas play through the charcoal. Next I got him to make a large condensing cistern beneath the stove, with an opening from it to convey the carbonic oxide by a tube into the lethal chamber, and with a tap, by which the condensed fluid could be drawn off. The arrangement answered straight away, if I may so say. The immediate combustion of the charcoal by the gas yielded very nearly the theoretical value of the product, carbonic oxide. The gas was deprived largely of water by the condensation; it was delivered over to the chamber with a steadiness sufficient for all practical necessities; it was cooled without any other artificial means, so as never to raise the chamber above summer heat; it was produced cheaply, and it afforded such simple action that any workman could at once learn to use it. It is just to say that the immediate success of my efforts has been much expedited by the use of Mr. Clark's stove.

Another useful result springing from the employment of this stove was that it enabled me to diffuse other narcotics into the chamber by allowing the gas from the stove to pass over a porous surface, charged with the narcotics, on its way into the chamber.

THE LETHAL CHAMBER.

To apply the narcotic gas or vapour it is necessary to have a closed place in which the animals are exposed to the narcotic, and another place in which they are collected preparatory to being subjected to the narcotism. This implies the lethal chamber and a cage.

For a large lethal chamber, strongly and effectively constructed, I noted down at the beginning the following requirements, calculated from a small working model.

(*a*) The chamber must be so constructed that the temperature and dryness of its interior shall be at all times uniform. (*b*) It must have sufficient but not excess of room in it for the expansion of the gases introduced. (*c*) The stove must be so connected with the chamber as to make sure of equal diffusion of the gases or vapours through the enclosed space. (*d*) A sufficient quantity of the narcotic must be introduced before, and for a brief period after, the introduction of the animals. (*e*) A plan must be provided by which the chamber can be kept completely closed until the precise moment when the animals have to be introduced, then instantly opened for the introduction, and as instantly closed after the introduction. (*f*) It is requisite to guard the entrance into the chamber, so that the men employed in pushing in the cage shall be protected from the vapour. (*g*) Lastly, a method must be adopted by which it can be known when all the animals have ceased to breathe.

To meet the above-named conditions, I constructed the lethal chamber, depicted in Fig. 1, p. 76. The chamber is built of well-seasoned timber, with a double wall, the interspace filled with sawdust. The plan has answered all my expectations. Should iron ever be used, and I can imagine that it is sure to be, it will be essential to have a double wall and to fill up the interspace with an inch layer of Croggon's felt, or with the peat felt of Mr. Versmann. Every portion of the construction ought to be, in this manner, double lined. Should the chamber be built in brick, the wall should be of 9-inch thickness, and of glazed brick in the interior. I am of opinion that a well-built brick chamber would answer excellently well. The roof of such a place should either be an arch of brick, or iron, or of wood closely covered with felt. An inner lining of wood, covered with felt, and overlaid with galvanised iron, would be very effective.

In order to obtain the slight excess of space which was wanted to insure diffusion, I formed on each side of the chamber an extra space, which I call a pocket. The spaces, one on each side, are in the centre on each side, and stand out as aisles from a central nave.

In order to secure quick and equal distribution of the vapours through the chamber from the stove, I let the gases in half way down the sides of the chamber. By using two stoves, one on each side, this method of introduction was both convenient and effective. To remove the common air, an opening, with a shaft of ten feet, was made in the roof. The shaft has a bore of three inches, and has a cap at the top in order to prevent down currents of air. At the foot of the shaft is a damper, which can be opened and closed at pleasure. The directions to the managers are, to open the damper when the stove is first lighted, and let it remain open for half-an-hour; then to close it partly for another half hour, and after that to close it entirely, until the chamber is again required.

To meet the fourth necessity, a plentiful supply of the narcotising vapour, two stoves have been connected with the chamber, each capable of burning two pounds of charcoal per hour, and giving up the products of the combustion into the chamber. At first, guided by the general, but not quite correct, impression as to the extremely poisonous qualities of carbonic oxide, I was content with one stove, but found it not quite sufficient, for although it delivered fifty cubic feet of the gas per hour, it acted too slowly. I therefore added a second similar condensing stove, which has proved abundantly sufficient.

To make the narcotic effect still more certain, and to keep the chamber at all times lethal, I have added an extra provision. At the two points where the tubes from the stoves enter the chamber, I have interposed two strong boxes made of elm, and covered with thin lead. These boxes, which are 18 inches long, and 4 inches broad, are filled loosely with the porous burnt loam, known as Verity's gas fuel, an excellent substance for filling a grate where coal gas is burned instead of fuel. This substance is so porous, it takes up narcotic fluids most readily, holds them in its pores, and gives them up in volumes of vapours when warm gas is passed over it. Into the boxes closed in with this fuel there is a funnel at the top, for supplying the fluid, which funnel can be shut with a stopper; and, at the end of the box, standing out at a right angle from it, is a continuous

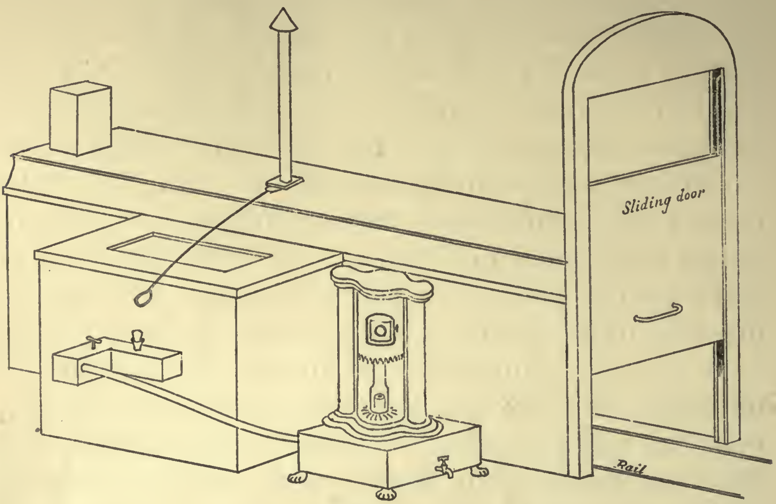

FIG. 1.—THE LETHAL CHAMBER.

section, in which there is a large plunge or tap, for regulating the currents of gas from the stove.

When the stove is in action, the tap, or plunge, is turned on, and the gases from the stove pass through the box and over the patent fuel into the chamber. Nothing more is done until just before the time when the animals in the cage are to be introduced. Then ten fluid ounces of an anæsthetic mixture, consisting of equal parts of methylated chloroform and carbon bisulphide, are poured upon the fuel through the openings in the top of the boxes, upon which the openings are immediately closed. After the animals are in the chamber, ten ounces more of the same mixture are added, and if, after three or four minutes, any of the narcotised animals are still breathing, ten to twenty fluid ounces more are poured in, but it is rarely necessary.

In pushing the charged cage into the chamber there is naturally a very great displacement of gas or vapour within. The cage has a cubic dimension of 160 cubic feet, and the chamber, with the side spaces, has 200 cubic feet. To put in the charged cage was, therefore, equivalent to displacing much of the narcotic gas or vapour which it contained. As a consequence, it was necessary to provide an exit which would save strain on the walls of the chamber, and should let out the proper amount of gas without letting in common air. The task was one which called for considerable patience and trial of method. I met it at last by the plan shown in Fig. 2, p. 78, which exhibits the chamber in section. Two feet from the far end of the chamber there is suspended, from the top, a light hanging screen, which reaches within four inches of the floor. Behind this screen, and in the roof of the chamber, is a shaft, with a valve opening upwards. As the cage is pushed in, this screen is raised from the bottom, and the air, rushing out at the lower part, ascends behind, and escapes by the valve. The screen is so balanced that, when sufficient air has been extruded, its lower end reaches the back or lower end wall of the chamber. The screen itself thus acts as a regulating valve, and when the pressure is off it returns to its level, letting any gas at the rear of it return towards the cage.

To enable the operators to introduce the cage quickly, and at the same time to protect them from the action of the vapours, the following plan, also indicated in the section diagram, is adopted. The door or entrance into the lethal chamber is a slide like the sash of a window. It is placed between two strong uprights, and is balanced by a weight and pulley in each, so that it can be opened and closed with the greatest rapidity. Behind this sliding door there is placed what I call the shield or block. The shield, as shown in Fig. 3, is a framework of wood with four large metal valves, two opening inwards, two outwards. The shield is fixed

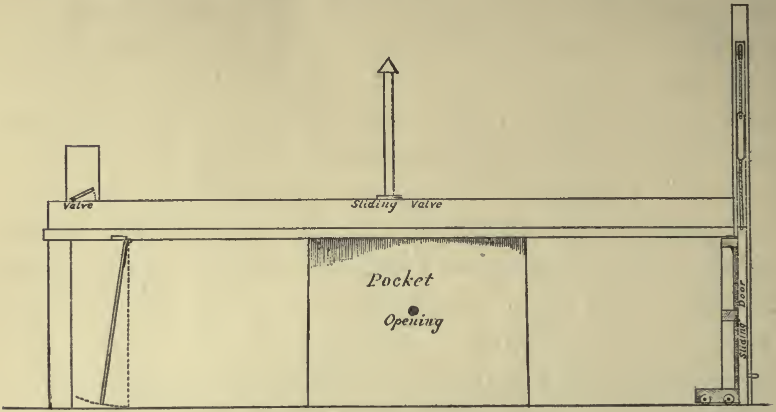

FIG. 2.—SECTION OF FIG. 1.

on a base resting on four little wheels, and runs easily up or down the chamber. When the sliding door is raised the movable valved shield is in position half a-foot within the chamber, and cuts off all escape of vapour. The workmen thus have time to push the cage leisurely, after the door is raised, into the chamber until the end of the cage touches the screen. This effected, they push the whole cage rapidly into the lethal atmosphere, the shield running before it, and then the sliding door is brought down into its place. When all is nicely adapted, a very few seconds are required to introduce the cage and close the sliding or entrance door. When the cage is drawn out the screen is drawn out with it by means of a cord which is attached to it, and which runs under the cage.

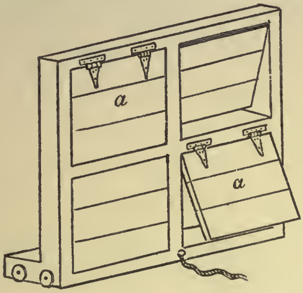

FIG. 3.—THE SHIELD OR BLOCK.

The last requirement which had to be met was the means of knowing when the narcotised animals had ceased to breathe. To get at this fact, the test of hearing was found to be the best. There is inserted into the chamber on one side a long stethoscope, made of bamboo; the mouth of this tube—of trumpet shape—is in the centre of the chamber, just above the cage, when that is in place. The outer part, or ear piece, of the tube stands out four inches on the outside, and is closed, when not being used, by a solid plug. On listen-ing through this tube, the continued breathing of even a single animal can be detected, and the operators are enabled to determine if it be proper to increase the strength of the narcotic atmosphere or to stop it.

I have now given all the necessary details of the chamber, and have only to add that it acts so well I do not think I could improve upon it in principle if I were to construct a new one. The gases act rather rapidly on the metal pipes leading from the stoves, giving rise to some little leakage when the pressure is full on, and rendering it requisite to replace the tubes from time to time. But these are minor details which are a part of all working mechanics, and which call for nothing more than moderate attention and intelligence on the part of the men in charge, who are very soon conversant with all that has to be carried out, and with any defects that may arise.

THE CAGE.

In the diagram (Fig. 4) will be seen the best description of the cage in which the animals are collected before being put into the lethal chamber. The cage is made of a wooden framework, with light iron side bars.

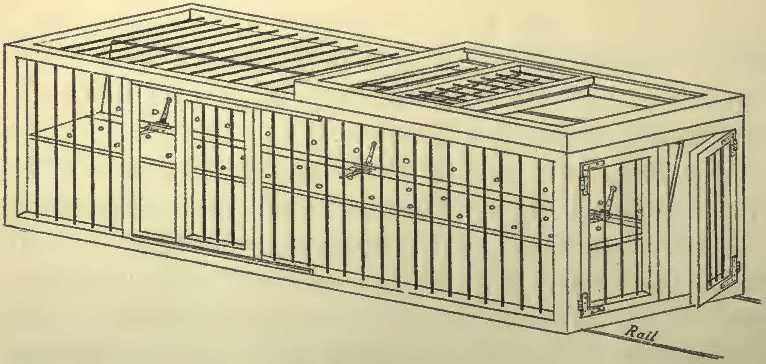

FIG. 4.—THE CAGE.

It has two sliding doors at the sides, two at one end, and one at the top. It can be filled and emptied through these doors with great rapidity. In order to hold as many animals as possible without discomfort to them, the cage is divided into two divisions or tiers, the flooring of the upper tier being freely perforated with openings, so as to establish a communication between the upper and lower divisions, and to allow a due distribution of the gases and vapours used. The cage runs on four eight-inch wheels, which are underneath it, and ply on galvanised iron rails. At the Home there are two cages, in order that one operation of painless killing may follow at once upon another if that be necessary.

THE LETHAL PROCESS.

Having now given the details of the mechanism employed, I may describe, with advantage, the nature of the lethal process. The mode of death to which the animals are subjected is by anæsthesia, not by suffocation or asphyxia. Physiologically, there is a distinctive difference between these modes of death. Death by anæsthesia is death by sleep; death by asphyxia is death by deprivation of air. Death by anæsthesia is typically represented in death by chloroform; death by asphyxia is typically represented in drowning, or in immersion in carbonic acid gas. Death by anæsthesia is the least violent of the two processes, although both are probably painless. The anæsthetic death is as certainly proved to be painless as any such thing can be proved. In all but fatal accidents from chloroform in the human subject, we know, on the evidence of the persons who have passed through the ordeal, that there is no sense of suffering up to the extremest approach to death; and as we cannot suppose that the lower animals are more susceptible to pain than the highest animal, man, we must consider the death absolutely free of pain. An intense impression of sleep lapses into the sleep that is final.

It is worthy of record, however, that all animals are not equally susceptible to the action of the narcotic vapours. Cats, for instance, before they cease to breathe, lie asleep much longer than dogs. They fall into sleep as rapidly as dogs, but do not pass so quickly into the final sleep. In the same narcotic atmosphere a cat will live twice as long as a dog, suffering nothing, and lying in deep sleep, but still breathing.

There is a difference between different animals of the same kind. Some dogs die almost instantly, in fact, as they fall asleep; others fall asleep and continue to sleep for several minutes before they cease to live. In the first observations, before I had rendered the narcotic atmosphere overpoweringly active for all cases, there were a few instances, nine in the seven hundred, in which some animals slept on for half-an-hour, some for an hour after all their comrades had died. Finding out this strange peculiarity, I increased the amount of narcotic vapour until all succumbed very nearly at the same minute, and in the last six thousand there has been no recurrence of the prolonged insensibility. The animals are now, commonly, all asleep in from two to three minutes, and have ceased to exist in a further period of the same duration. In order, however, to prevent any chance of recovery from the sleep on exposure to air too quickly, the instruction is that the chamber shall on no account be opened until one hour after the introduction of the cage.

By introducing some other vapours into the lethal chamber with the chloroform, the vapour of hydrocyanic acid for instance, the death, no doubt, could be made more rapid, and indeed instantaneous. To this plan there are two objections, which are, I feel, final. In the first place the death would be less peaceful; in the second place, the atmosphere produced would be extremely dangerous to the men employed.

A SMALLER AND PORTABLE LETHAL CHAMBER.

The success of the trial on the large scale has led me to the construction of an apparatus on a small scale, an apparatus which can be moved easily from place to place, which can be kept at different parts of a city or town, at a police-station, a veterinary surgeon's, or at any institution that will take it in charge. I entered on the construction of this machine some months ago, with the conviction that I could complete it in a few weeks, and have it ready for use at the Home in cases where only one or two animals have to be destroyed. I am sorry to say that the road to success was not so easy. I have had, in fact, to construct no fewer than four chambers previous to getting in complete working form what I desired to secure.

The difficulties have arisen from three sets of circumstances. Firstly, that in a portable machine fitted for action at a few minutes' notice, it was not possible to have a fire or stove. Secondly, that in order to make the chamber adaptable to animals of different sizes, it was necessary to make it changeable in size. Thirdly, that the substance used for causing the anæsthetic death should be so cheap as to render the process generally applicable. I began by employing coal gas and chloroform, but here, again, was met by the danger of explosion. Then I proceeded to the study of the application of compressed carbonic oxide, which would answer well, but for the expense which would attach to this mode of applying it. Next, I passed to compressed gas with vapour of chloroform and carbon disulphide, but again found the cost too great. Lastly, I fixed entirely on the plan of surcharging common air with narcotic vapour either by a bellows, or forcing pump, or a fan, which plan answers exceedingly well.

In the diagram (Fig. 5) there is shown a view of the portable lethal chamber ready for use. It will be seen that the apparatus takes the shape of a closed truck on two wheels, and is movable like a truck or barrow. It measures 5 feet in length, is 2 feet wide, and 2 feet 6 inches high. It moves very easily, and can be managed by one man. It is constructed, like the large lethal chamber, of well-seasoned wood, in double wall, with sawdust filling up the interspace. In a second diagram of it (Fig. 6), the apparatus is shown in section.

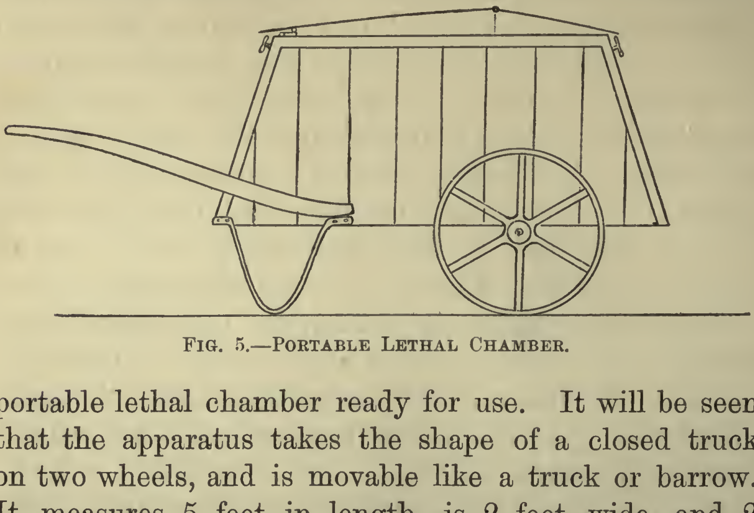

FIG. 5.—PORTABLE LETHAL CHAMBER.

As will be seen, there is here one large chamber, having a capacity of nine cubic feet. The chamber opens at the top by a strong lid, swung from behind, which, when brought down, entirely closes up the chamber. Under this lid there is a frame with an opening in the centre, through which baskets or cages of different sizes, and containing the animal or animals, can be let down into the larger space, and fixed there. This larger space is the narcotising receptacle or chamber.

At the back of the apparatus is a recess in which is placed the narcotising fluid, and the pump or fan for forcing it into the cages containing the animals. The narcotic fluid is contained in a large strong Wolff's bottle filled loosely with Verity's fuel. The forcing pump or fan is worked from the outside, and conveys one-eighth of a cubic foot of air or gas with each movement. From the forcing apparatus are two tubes, one of which runs into the narcotising chamber at the lower part, the other to the long tube in the Wolff's bottle below the surface of the narcotic fluid

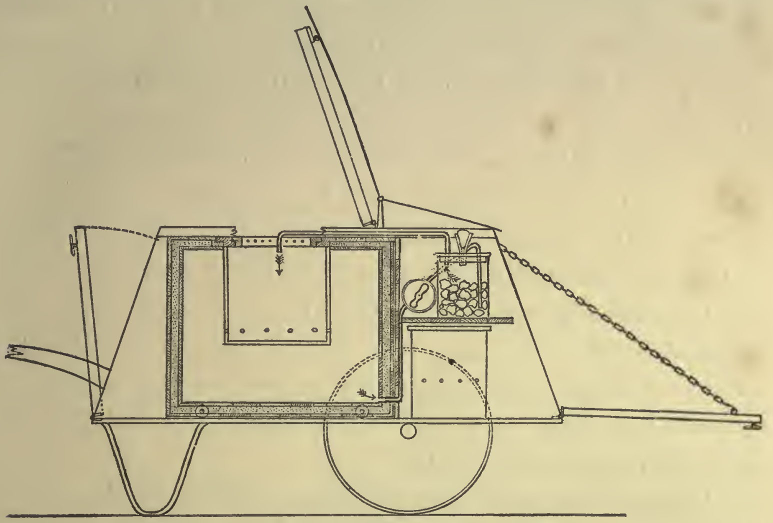

FIG. 6.—SECTION OF PORTABLE LETHAL CHAMBER.

within the bottle. From the short or escape tube from the bottle is a continuous tube, terminating over the cage containing the animal. By an extra tap, coal-gas can, if desired, be let into this chamber.

MODE OF PROCEDURE.

The animal to be slept into death is placed, resting on a little straw or hay, in a cage, which is then dropped into the large receptacle, the lid of which is at once closed. If a pump is used the piston is then moved up and down at a regular and quiet pace. As the piston is drawn out, the cylinder of the pump is filled with air from the large receptacle, and as the piston is pushed back it forces the air with which the cylinder has been filled through the narcotic fluid, a portion of which it raises into vapour and forces into the cage. Eight strokes of the piston charge one cubic foot of air with the narcotic vapour, and a couple of minutes are sufficient to charge throughout. A fan charges as rapidly.

The animals in this apparatus pass easily into sleep, and die not quite so quickly, but quite as painlessly, as in the larger lethal chamber.

This smaller apparatus will be so complete when it is finished, that it may be wheeled from its station to a private house, if that be wanted; or it may be used in the streets for giving painless death to wounded animals. It may also, in future, be constructed at so comparatively trifling a cost, that I see no reason why every town in the country may not be in possession of one, and every small animal be spirited away in sleep.

Compared with other modes of extinguishing animal life—such as hanging, drowning, poisoning by prussic acid, shooting, stunning—the lethal method stands far ahead on every ground of practical readiness, certainty, humanity. I cannot, however, let the opportunity pass of testifying that the method carried out for twenty years at the Dogs' Home, of killing with prussic acid, has been, by the skill and experience of the operators, brought to a great state of perfection and painlessness. The objections to it are moral and physical. It is a tax that few men can usually bear, to have every week to take scores of dogs, one after another, and by force administer to each one, singly, the deadly poison. Further, the poison is so deadly I look upon it as almost a miracle that no man has been accidentally killed by it during the process.

LETHAL DEATH FOR ANIMALS TO BE USED AS FOOD.

It will be observed that hitherto I have dwelt only on the process of lethal death in its application to small domestic animals, such as dogs, cats especially. I am expected to add something more in reference to the painless destruction of those animals which supply us with food; but as the Society over which I have the honour to preside, the "London Model Abbatoir Society," is about to build a model slaughter-house, in which painless killing will form an important feature, it would be premature to enter into any details, until by careful trial the best methods have been secured. I may, nevertheless, be permitted to indicate that in respect to certain animals the painless death is quite feasible. By means of carbonic oxide, sheep can be put to sleep, with the greatest rapidity, before they are slaughtered. I have submitted forty sheep in this way to painless death, and found that no bad effect whatever is produced in the flesh, unfitting it for food. The objection to retention of blood, so strongly felt by the Jewish people, does not obtain, the animals in the narcotic state yielding up blood just as freely as in the ordinary way, when no narcotic is used. The same process may be applicable to swine, calves, and fowls. To oxen I do not, as yet, see its application. I have several times been asked whether there is any other method for the painless killing of animals intended for food which might be considered by the side of the lethal method. There is only one other mode which is really worthy of consideration, and that is the mode by the electric shock. The electric shock for this purpose was first proposed by the illustrious Benjamin Franklin, some twenty years after he had proved, by the famous kite experiment, the identity of the electrical and the lightning discharge. His suggestion is supplied in a letter, which he wrote in 1773, to MM. Dubourg and D'Alibard.

In pursuit of Franklin's idea, a friend of his, Mr. Collinson, an Englishman, endeavoured to carry out the method in practice, in which attempt he himself received a shock, which told him that electricity was no respecter of animals. The experience put an end to the proposed method until the year 1869, when I revived it by means of the large induction coil at the Royal Polytechnic Institution, as described in THE ASCLEPIAD of July last.

I do not despair altogether of making electricity practically useful for the extinction of life of some of the larger animals, such as horses and oxen. I have in view the construction of a porch through which a large animal may be conveyed on a truck, and during the passage through which and in no other position it may receive the fatal shock. But at present the expense connected with the carrying out of this suggestion would in itself be a barrier to success.

NOTE ON THE EXPENSE OF THE LETHAL PROCESS.

The use of the word expense leads me, finally, to refer to the expense of the lethal process.

In what has been done up to the present time, so much has, of necessity, been experimental, it would not be fair to calculate the expenditure connected with these first efforts as a guide to what would be the cost of a new apparatus made from the completed design. Roundly, I may say that the prime cost of the large chamber and cage, for material and labour exclusively, was, in the first instance, about £145. Since then, another cage and another stove have been added, together with iron lines, now being fitted, and with various alterations which have increased the expense. I think, however, that such a chamber, starting afresh, with all the details now understood, could be constructed for from £150 to £175. The smaller chamber has cost, in the original working out, a larger sum in proportion, owing to the difficulties of adapting it to all requirements demanded, and the frequent reconstructions. Now, however, that it is brought into practical form, it may, I think, be constructed for £50, and if there be a demand, for a lesser sum.

The cost of charcoal for the stoves with the addition of anæsthetic fluid is, in the large chamber, a little over one halfpenny per animal when eighty to a hundred are killed at one time. When fewer are killed the expense is a little increased; the trouble and anæsthetic substance required being the same.

The cost of working the little chamber is not so easily reckoned, inasmuch as the labour for moving it from one place to another will vary, while the quantity of the anæsthetic necessary for destroying one animal will be nearly as much as for six or eight introduced at once. In any place where the small chamber is retained as a fixture, and where it is kept carefully closed, it will at all times be charged with anæsthetic vapour, and be very little more expense than the larger apparatus.

CONCLUSION.

I bring my lecture to a close with the reflection that science, often considered hard and unrelenting, has in this case another and different feature. If she sometimes, for the sake of man, inflicts pain on the lower creation, here she relents and does for the lower creation what she dare not do for man. By comparison, the boon is enormous. Except for the corporeal suffering, the dumb animal seems to have no pain in death, while to man—

> "The sense of death is most in apprehension."

Thus he who wrote the Burial Service expressed the most universal of desires "that at our last hour no pains of death may fall." Perchance for himself and his own kin, man, with all his ingenuity, will never see his way to escape that desire, until by a better life he wins the death by natural sleep, which nature has ordained to be as painless as his birth. Grateful, nevertheless, may he be that the power is in his hands of giving to his inferior earth-mates what he prays for, Euthanasia.

COTEMPORARY PRACTICE AND LITERATURE.

> "*Every physician will and ought to make observations from his own experience; but he will be able to make a better judgment and juster observations by comparing what he reads and what he sees together.*"—Friend.

THE OVER-PRESSURE QUESTION.

"WHILE I do not venture to impugn the many interesting statements in this report so far as they are based on statistics, on books, on information accessible to the general public, and on medical science, I do not hesitate to say, that every one of the judgments which purport to have been formed by Dr. Crichton Browne's visits to schools, appears to me to be hasty and inaccurate, and to have been arrived at by a loose and partial method of inquiry."

This is the verdict of Mr. J. G. Fitch, one of Her Majesty's Chief Inspectors of Schools, on Dr. Crichton Browne's report to the Education Department upon the alleged over-pressure of work in Public Elementary Schools, and I can well conceive that from his point of view, Mr. Fitch had no alternative but to come to that conclusion. Mr. Fitch has many advantages over Dr. Browne. He has been trained to observe in the school, and to know precisely what every beck and word, and, I had almost said, thought, of the children of the school is worth. Dr. Browne went into school-land a stranger to it and its ways. So it is not wonderful that Mr. Fitch should find his medical opponent tripping at various points, and it may be, as half suggested, amusing the youthful audiences not a little by a primitive and, to them, innocent mode of inquiry into the health of their minds and their bodies, with an attempt, at the same time, to detect how far the body may suffer from strain of the mind.

After all, the public sympathy and the public common sense have gone with Dr. Browne. The novitiate has beaten the master. *Novacula in cotem.* The explanation of the success is easy enough. Dr. Browne has seen with new, Mr. Fitch with older and less wondering eyes, what are the evils of over-pressure. Mr. Fitch, too familiar with the evils which a fresh man would be sure to detect, is surprised at what was described to him. I do not wonder at the phenomenon, because I have felt it myself. The sick patients in a dispensary hospital soon begin to look less sickly and peculiar to the physician than to the student. The insane in an asylum are not so strange to the attendants as they are to visitors. The poor are not so poor to the poor as they are to the rich. The school children are not so oppressed to the masters and mistresses and inspectors as they are to the outside inquirer, who comes unprepared to a novel scene. I remember, for my own part, as bearing on this very question, that when I got accustomed to enter schools, to watch the system of teaching, I very soon became unconsciously disabused of much which, at first, I felt to be intolerable.

Comparing carefully, and I hope without prejudice, the statements and arguments of the two writers, I have no alternative but to throw in my vote with the majority, and express the belief that, on the whole, Dr. Crichton Browne is nearest to the truth, and that there is an excess of pressure in school work, book work, mental work, which is neither healthy for mind nor body. Were the children better fed there would, perhaps, be less appearance of evil; but even then it is doubtful if, in the long run, the book work is not more than is required, since well-fed children also suffer from the evils of over-pressure. The remedy lies in making physical education a distinctive part of school life amongst all classes of children, and in letting the necessities of the nation be the first consideration for the education of it. If Dr. Browne has, in some instances, made a novitiate's error, he has done good service by the courageous spirit in which, at the risk of such error, he has told a world of truth.

COCAINE.

THE alkaloid cocaine, which underwent a careful exhaustive inquiry several years since by Dr. A. Hughes Bennett, has come into much note during the past quarter, as a local anæsthetic on a mucous surface. Its value seems to me to have been, at the best, very much overrated, its application, with success, being chiefly confined to operations performed on the eyeball, and then only to those which are superficial. The thin outspread of mucous surface over a negative surface is probably the cause of this special success, and to a large extent indicates the limits of the success.

The extreme sensitiveness of this mucous surface is due to the same cause as its quick and easy anæsthesia. All absorbable anæsthetics, which do not irritate, readily produce local anæsthesia of the conjunctival surface. A watery solution of opium does, a weak solution of aconite does, and I feel sure that several alkaloids will be found which will exert a similar influence. I found in my experiments with cold that an extremely moderate reduction of temperature had the same effect, and that the application of ether spray over the closed eyelid was sufficient to render the conjunctiva insensible to touch, without actually freezing it. It must be borne in mind, in following up this inquiry, that in local anæsthesia we are open to many errors of observation, and that opinion upon it can scarcely be expressed too cautiously, because there is so much difficulty in arriving at true subjective evidence. In all the experiments which I and others—Snow, the late Augustus Waller, Nunnerly—carried out for the production of local anæsthesia by the local absorption of narcotics, we were, at first, much misled by the difficulty I have described. I name these points, not for the sake of being critical, but to check, from experimental knowledge, a too hasty aspiration. I can see clearly why on the conjunctiva, which so to speak is insulated, local anæsthesia is producible by many narcotic alkaloids. I do not see so distinctly that because this is so, we have reason to suppose that cocaine will be a local anæsthetic to the skin or to mucous membrane resting on a deep cellular basis, into which there is rapid absorption of the anæsthetic from the sensitive structure, with quick removal of it, by further absorption, into the circulation. At the same time I hope, against hope, that my fears may turn out fallacious.

REVIVAL OF OVARIOTOMY.

SIR SPENCER WELLS, in an address delivered at Birmingham before the Midland Medical Society, traces out with much care the progressive steps by which the remarkable operation of ovariotomy has been brought to its present perfection. The address is felicitous in mode, and, with an exception or two, is extremely valuable as an historical record. There is one point omitted, by necessity, which I, as an all the while looker-on, may fill up. The address conveys no suspicion of the intense labour, ever-watchful anxiety and unrest, which the author of it passed through in the first and second stages of his career as an ovariotomist. It would be an advantage for coming writers if the author of this address would give it a more permanent character by re-casting it with the appendix interweaved into the body of the work, and with more elaboration of detail. The mere accident that the address had to be read in an hour, on its delivery, ought not to govern its future fate.

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RHIGOLENE OR AMYL HYDRIDE.

SOME public references recently made on Rhigolene as a local anæsthetic require correction. Rhigolene (or Amyl Hydride), a light fluid, boiling at 86° F., has no local anæsthetic properties except by the cold it produces when, like ether, it is projected on the body as spray. I used it in this way for local anæsthesia in 1867, in the form, since so generally known and employed, of compound anæsthetic ether, a mixture of anhydrous ether and Rhigolene in equal parts by volume.

POST SCRIPTA.

Mr. Wynter-Blyth's Observations on the Ingesta and Egesta of Mr. Edward Payson Weston during his walk of 5,000 *miles in* 100 *days* is published in the Proceedings of the Royal Society, No. 232. 1884. The observations deserve the most careful perusal, and may be read with much interest by the side of the Report of Professor Flint, published some years ago, on the same topic.

River Sanitation is the subject of a vigorous and seasonable essay by Mr. William Burchell, the object being to induce a public movement for the prevention of river pollution. "Two things," says the writer, "are clearly demonstrated: that the present legislation is wholly insufficient, and that the sanitary authorities are not fit to be exclusively entrusted with powers to preserve our rivers from pollution."

The Treatment of Strabismus by the Faradic Current, to which I drew attention in my last number, has attracted much attention. I regret that in the article there was an omission of the previous labours in the same direction, by Wells in 1861, Brudenell Carter in 1869, and Buzzard in 1875 (*vide* Neale's *Digest*, section 1811, 5).

The Double India-rubber Stethoscope, described in THE ASCLEPIAD of April last, page 162, is made by Messrs. Krohne & Sesemann, of Duke Street, Manchester Square.

THE ASCLEPIAD, although it appears in the serial or magazine form, is a book exclusively of single authorship. The title-page carries this fact, but it has become necessary to restate it in order to prevent an error of some cotemporaries, who speak of the work as if its Author were in the position of Editor.

THE HYGIENIC TREATMENT OF PULMONARY CONSUMPTION.

THE progress of hygienic medicine in the last fifty years is the medical fact of the present age, and the fact that will stand out in boldest relief when the history of this period shall be written by some future Esculapian scholar.

But, rapid and effective as this progress has been, the principles of hygiene are yet in their infancy. We have learned to appreciate the true value of hygienic principles in the prevention of diseases of the epidemic type; and the medical profession, throwing aside all selfish recollections, has been the first to teach the practice of these principles, and to prove their force and vitality. The next step in the way of advancement is to demonstrate that the same principles are as useful and as necessary in the treatment of actual disease as they are in prevention.

A great advantage in the hygienic treatment of disease is, that it does not, or at least need not, interfere with sound and experience-proved modes of treatment of a medicinal kind. The scientific physician finds, in fact, that there is always a consistent plan for combining the medicinal and hygienic systems. He sees that the two systems are one; he sees further that the mere medicinal plan without the hygienic is in all cases imperfect, and in some cases worse than imperfect.

The practical details of hygienic medicine in relation to the treatment of disease have, however, yet to be wrought out more fully. This will be sure work, but slow. Necessarily slow, because it is hard to give up old friendships in dogmatism; while to effect a cure in a sick man by fresh air alone, or diet, is infinitely less satisfactory to the public, than to assume to effect the same cure even by a bread pill.

It is vain, it is sticking in the slough of hopelessness, to pander to these popular weaknesses; for though they must die out, and, indeed, are dying out daily, they will go the sooner if they are effectually damped, and if something real and common sense is put in their place. *Scientiæ mutantur, et nos mutamur in illis.* There is a time when medicines are invaluable; but if faith in medicines is to be retained, the times for their administration, as well as their selection, must be learned by knowledge, not by routine, and must be dictated by the circumstances of the case, not by the caprice of the patient. The executive of medicine must be independent, if it would keep in the path of truth and advancement.

In such progress as has been made in the science of treatment by medicines, it has been found useful to take up certain particular diseases, and to observe in them, individually, the effects of particular remedies. This rule will apply with equal force in considering and investigating hygienic modes of treatment. Each practitioner should, as his opportunities permit, observe as carefully the effects of his hygienic commands, as he does those of the medicines he may prescribe. He should compare also the one mode with the other, and calculate in each case their relative advantages. In this way he will have the opportunity of detecting with greater accuracy the pure effects of medicines themselves; seeing that the action of medicines is greatly modified by the external conditions to which he who takes them is subjected.

Convinced of the importance of the above considerations, I have made it my business for thirty years past to mark out a series of hygienic rules for the treatment of consumptives; and as I have had the best and widest opportunities of carrying out these rules in practice, and as the results have been satisfactory, I lay the views published, originally, while I was one of the physicians to the Royal Infirmary for Diseases of the Chest, once again, and briefly, before the public.

In giving the following rules I pre-suppose their general applicability to cases of consumption in all stages of the disease: in the premonitory stage; in the stage when the tubercular deposition is evident; and in the next stage, when the local mischief is much further advanced. In the last stage even, though hope is lost, many of the rules may still be followed out with advantage, for by them the course of the disease is smoothed, and sometimes life is prolonged. In like manner, the rules are generally applicable to those who by hereditary taint are as yet but predisposed to the disease.

RULE I.

A supply of pure air for respiration is the first indication in the treatment of the consumptive patient.

In all cases of consumption, the attention of the physician should be at once directed to the quality of the air breathed by the patient.

In large cities, and even in small towns, it is next to impossible to get a constant supply of pure air in inhabited houses; for houses are built according to false notions of comfort. "What a nice cozy room!" is a common expression applied innocently to every place where the greatest care has been taken to make an air vault, without a "draught," and all ready for being charged with invisible impurities.

In a cozy room the consumptive is bound never to live, nor indeed in any one room for great lengths of time. So long as he is able to be out of doors, he is in his best and safest home. In the fields, on the hills, wherever the fresh air vivifies, where plants look most vigorous, and animals frisk about in the joy of health, there will the consumptive draw in his choicest medicine, there meet most advantageously the dangers of his disease, and there repair most easily the waste of tissue.

The inclemencies of the weather may temporarily, it is true, prevent the patient from his out-door existence. But even these inclemencies are not so much to be dreaded as confinement in a house. I have had occasion repeatedly to remark that if, from a few days' rain, the consumptives under my care were confined to their homes, instead of being able to take the daily out-door breathing invariably prescribed under such circumstances, the aggravation of symptoms was always marked and universal. The appetite fell off, the debility became greater, the mind was less buoyant, the local mischief increased. The patients, too, previously accustomed to a full dose of the air food, were not ignorant of the cause of these changes, for reduction in air is felt as quickly as reduction in common diet. Seeing these evils, then, I have long since thrown off the alarm about bad weather, and have ordered every patient to seize, even in an inclement day, each gleam of sunshine, for the purpose of getting out for a breath of fresh air. The result of this practice has been most gratifying in all cases where the courage of the patient has admitted of its application.

Dr. Jackson, in speaking of out-door life, in much the same terms as the above, dwells very properly on the necessity of securing for this plan the confidence of the patient. The treatment "should not be done rashly, but boldly." If possible, "the patient should be made to have faith in it; for without this he is not likely to pursue it as far as he can, and then he will not derive from it all the benefit which it can afford." This is the fact; but the difficulty is at once got over if, under favourable conditions, the invalid can be induced to try the measure for a few days. Once tried, there is no fear, in the majority of cases, of its being given up, except in instances where the disease is too far advanced, or where, from the poverty of the patient, the pursuit of a sedentary occupation must needs be followed, even to the last days of existence. The benefit derived from this treatment is indeed so obvious, the debility is so much better borne, the relish for food is so much more markedly felt, the nights are passed with so much less of restlessness and cough, and with such an increase of sleep, that the sufferer soon instinctively feels the value of his instructions, and follows them out even more punctually than those which relate to the taking of medicines.

As much of the day, then, as is possible should be spent by the consumptive in the open air, and in places where the air is least impeded and least corrupted. When he is compelled to keep the house, the necessary precautions must again be taken for procuring a free admission of the atmosphere. No cozy room with a temperature of 70°, with every crevice closed, and with an atmosphere in a dead calm and laden with impurities, should be permitted. But the temperature should be 60° Fahr.; the fire, if there be one, should be in an open grate; and by a free chimney vent, secured by an Arnott valve, the freest possible current of air should be kept circulating through the room. If the patient is cold, let him approach the fire, but let him not labour under the popular and fatal error, that the way to obtain animal warmth is to shut out the air and roast the body. The heat of the body is made in the body itself, by virtue mainly of the oxygen supplied in the air; and as the body absorbs external heat with great difficulty, it would be as wise to attempt to give warmth by fires, hot bottles, and hot air, to a man who is not inhaling a due amount of oxygen, as to attempt the same process on a marble statue. In a word, external heat is useful only in preventing the too rapid radiation of animal heat from the surface of the animal body. Alone, it cannot supply heat; but when a wholesome air is inspired, it can secure the retention of the heat that is developed in the animal furnace.

I spoke a moment ago of the open fire-grate. This is an essential for the room of the consumptive. Stoves of all kinds, heated pipes, and, in a word, all modes of supplying artificial warmth, except that by the radiation from an open fire, are, according to the facts which I have been able to collect, injurious. They are injurious because by their means the air is made too dry, an objection much less applicable to the open fire.

The symptom which I have most commonly seen elicited in the phthisical, by the inhalation of an unnaturally dry air, is hæmoptysis, a symptom brought on frequently by the constant cough which the dry air excites. This effect, in a minor degree, will, in fact, appear in some cases without any actual deposition of tubercular matter, under the influence of the same cause.

The temperature of the air in the room of the consumptive should be carefully watched by the patient himself. My friend Mr. Glaisher, than whom no one is more competent to speak on this point, recommends two thermometers, the one with a wetted bulb. By the use of these the humidity, as well as the temperature, can be regulated. This is most advantageous, and the sensations of a consumptive patient soon inform him what degree of moisture is comfortable and proper.

I have occasionally heard phthisical patients complain of the use of gas in the rooms where they are confined. Such complaints, however, have usually come from patients confined in workshops where the number of burners is very great, and where there is almost always some accidental escape of gas.

In private houses such objections are avoidable ; but as the inhalation of coal gas is injurious even in small quantities, and as the products of the combustion of the gas are also hurtful, the necessity of a free ventilation in rooms where it is burned, and in which consumptives are lodged, is the more urgent.

The care that should be taken to secure a good air in the living rooms of the phthisical invalid must extend with equal care to the sleeping apartment. This rule should always obtain when possible : *never permit one room to perform the two offices of bedroom and living room.* The bedroom should be large, unencumbered by needless furniture, and thoroughly ventilated. If the temperature of the air without is not below 60° Fahr., the windows of the room should be boldly set open, and be kept open at the top all night. If they are to be closed of necessity, a free chimney draught must be procured, and an Arnott's valve is always an advantage. The bed should be free of curtains, but a single screen may be placed so as to ward off any direct draught from the door or window. Warmth of body is best secured by woollen bedclothes; but if the temperature of the air is below 60°, it will, with advantage, be raised to that pitch by a fire in the open grate. Gas should on no pretence be burned through the night in this bedroom, and as few other lights as possible, for the patient requires all the air that is to be had, and must not be carelessly robbed of it. Above all things, the consumptive person should be the sole occupant of his own bed and bedroom. To place such an one for several hours close to another person, however healthy, is injurious to both, but especially to the sick. No ties of relationship, and no mistaken kindness, should cause this rule of isolation ever to be broken.

It has been stated already that the room of the sufferer should be large. It should include, whenever practicable, at least 1,500 cubic feet of breathing space, under all plans of ventilation. If more space can be had, all the better. If less only is obtainable, then the ventilation must be the more carefully attended to.

When the patient has left his room in the morning—and he should do so early—the windows and doors should be set open, and a current of air be allowed to flow through it during the whole of the day. If the air of the apartment be at a temperature below 60° Fahr., or loaded with moisture, the fire should be lighted two hours before bedtime.

Consumptive patients frequently ask, especially in winter time, the value of what are called respirators; and I have known some poor people purchase things of this description at what was to them considerable cost. The use of mufflers, which are, in fact, respirators, has been known for ages; and Dr. Hales, more than a century ago, recommended a scientifically made muffler for persons obliged to enter into places where noxious gases were given off. Dr. Beddoes, too, as Dr. Arnott shows, pointed out, in the year 1802, that a few folds of gauze held over the mouth and nose made the air warm and moist for respiration, and that such mufflers were, therefore, useful to consumptive and asthmatic persons. The object of the muffler or respirator is this: it retains the heat thrown out in the expired air, and gives up this heat to the cold air that enters in inspiration. In cold dry weather the muffler is very useful, and should be worn by all phthisical patients when out of doors; but when the air is moist and cold it sometimes is complained of as embarrassing the respiration. It should then be thrown aside. Any patient may easily make one of these mufflers for himself, for the cost of a few pence, out of a piece of fine wire gauze, cut oval so as to cover the mouth and nose and fixed in the centre of a small Shetland shawl, so that it may be tied on like an ordinary comforter, with the gauze in the centre for breathing through. The metal gauze, plated or silvered to prevent rust, will last for several months, and in summer time can be removed from the shawl and laid aside; but the shawl is often useful in all seasons.

RULE II.

Active exercise is an essential element in the treatment of Consumptives.

The conditions for obtaining a due supply of air imply in some measure the necessity for exercise. But there are varieties of exercise. Drs. Rush, Jackson, and Parrish, are in favour of riding on horseback, but this is a thing not practically to be carried out in the majority of cases, and, as I think, not absolutely necessary. Walking is the more natural exercise; it brings into movement every part of the body, more or less, and, leading to brisker circulation in every part, causes a more active nutrition generally. Of late years I have very much recommended tricycling to consumptive patients, and often with great benefit. In many instances it is better than walking exercise, giving more perfect change of air and scene with less fatigue.

The extent to which exercise should be carried will vary with the stage of the disease, and temporary accidents—such, for instance, as an attack of hæmoptysis—may, for the moment, stop it altogether. But when exercise is advisable, the general rule is to recommend that it be carried out systematically, cautiously, and courageously, and that each exercise should be continued until a gentle feeling of fatigue is felt through the whole muscular system. Violent and unequal exertion of the upper muscles of the body is unadvisable. When restored from the fatigue of one exercise, another should be undertaken, and during the day this cannot be too often repeated. If the day be wet, then the exercise should be effected by walking in a large room, or by engaging in some game, such as skittles, billiards, or tennis.

If, in his waking hours, the consumptive patient can keep himself occupied pretty freely in muscular labour, he secures the best sudorific for his sleeping hours that can possibly be supplied; for as the force of life is always expended in producing motion or action, so, to use the words of Dr. Metcalfe, "the proximate cause of sleep is an expenditure of the substance and vital energy of the brain, nerves, and voluntary muscles, beyond what they receive when awake; and the specific office of sleep is the restoration of what has been wasted by exercise." Cough is very much less frequent in the course of the night in him who has been subjected to exercise in the day; while sleep, when it falls, is more profound, more prolonged, and more refreshing.

In summer time, when the temperature of the day is high, the morning and the evening time are the best adapted for the periods of out-door exertion. In the other seasons, mid-day is preferable, as a general rule.

I have been asked, often, whether dancing is good exercise for children and young persons of a consumptive taint. There can be no doubt that it is so when properly conducted. When dancing is carried on, however, it must be done in a very large room, freely ventilated, and scrupulously free from dust; for the more exercise the body takes, the more air it requires, and the less of encumbrances in the way of mechanical obstacles to a free respiration. In damp days, when walking out of doors is impossible, the consumptive child may thus have three hours' dancing with advantage; not in stuck-up bowing and scraping, finnicking, polite quadrillism, but in good active dances, that make every limb feel pleasant fatigue.

In the performance of muscular exercise let the consumptive never encumber himself, nor check the free movements of his body, by strappings, loads of clothes, carrying of weights, and the like. These are but tasks; they lead to unequal exertion in special sets of muscles, and to an inequality of expenditure of power which ought to be avoided.

A last consideration on the value of muscular exercise is, that it is eminently useful in keeping the respiratory muscles in a state of active nutrition. For, if to the loss of capaciousness in the lungs to receive air there is added a daily increasing failure in the muscles by which the acts of inspiration and expiration are carried on, it is clear that a double evil is at work. Now this double evil is most actively presented in consumption. As the respiratory muscles, together with the other muscles, lose their tone, so do the general symptoms of exhaustion increase in severity, sometimes without very marked change in the pathological condition of the lungs. In sequence, day by day, as the nutrition of these muscles decreases, and as they fail in tonic contractile power, they gain in excitability; so that the irregular spasmodic contractions to which they are subjected in the act of coughing are produced by the merest excitement, and the cough is more frequent as it becomes more feeble.

RULE III.

A uniform climate is an important element in the treatment of consumptives.

Consumptive patients are constantly asking questions as to the value of a change of climate. The poorest applicants for relief are anxious on this point, and are often ready at once to contemplate emigration, if the merest hope is given to them that such a course would prove beneficial. In considering climate, the fact should be remembered that the main point to be obtained is to select such a part of the earth's surface as presents the nearest approach to an *equality* of temperature. Different writers of eminence have given the most contrary opinions on climate and consumption. Some have recommended a warm climate, others the polar regions. Both parties have spoken from experience, and they are, in some measure, both right; for a climate equally cold, and a climate equally hot, are each much more favourable than one in which there are constant variations, and where the thermometer in the course of the year ranges many degrees from freezing point, up to 100° or higher. Speaking of 153,098 deaths from consumption occurring between the years 1841 and 1851, the Irish Census Commissioners observe:—

"As might naturally be expected, the seasons exercised a very marked influence upon the deaths from consumption. During the mild months of autumn, succeeding the warm season of summer, the deaths attributed to consumption amounted to only 23,010; with the cold of winter the mortality from this cause increased, so as to present a return of 38,956; but with the harsh trying weather of spring it rose to 51,334, and in summer fell again to 39,798."

This statement represents a very important truth. It is certainly best for the patient if the temperature, while equal, be also temperate; but a mean temperature of 35° on one side, or 75° on the other, is preferable to one varying constantly, to-day at 60° Fahr., to-morrow at 40°, and a few days later at 80°.

From the experience gained in taking charge of a large number of consumptive patients it becomes a remarkable and highly-instructive task to learn the influence of climatic changes on the symptoms of the disease. I can usually predict, almost with certainty, the history I am to hear from the consumptives who are coming before me. If for some days there has been uniformity of temperature, and the weather has been mild and dry, so that an airing each day out of doors has been effected, the visit is quite a cheery one; all seems better; the medicines are said to agree. The cough is less troublesome, the body is warmer, and hope, diffusing an inward sunshine, lights up each face with brightness and activity. In frosty days, too, when the air is dry and the temperature continues even, the symptoms are often equally favourable; but during periods, so common in this country in the spring and in the beginning of winter, when the atmospheric variations are sudden, marked, and often repeated in the course of a few weeks, the general aspect of affairs is widely different. I have heard on these occasions almost every patient complaining; the symptoms are all exaggerated, the mind discontented. There is a general request for a change in the medicine. Something is asked for that will soothe, for the nights are passed indifferently. It is useless to comply always with these demands, since the exaggerated train of complaints has a general and common cause; but now and then the modification of symptoms is so great as to call for a modification of treatment. During these variations of season, deaths from consumption are most prevalent.

Thus an equable temperature is of great moment, and should always be sought after by the phthisical sufferer. If he cannot remove from his own locality, and if the variations in it are considerable, he must take the best precautions at his command. In-doors it is not difficult to sustain a pretty even temperature, varying from 55° to 60° Fahr. Out of doors, something must be done by attention to clothing, and by the use of the respirator. The most marked variations, however, occur in the night, and hence the importance of keeping up an equality of warmth in the bedroom, in the manner already described.

The reasons why consumptives feel the effects of climatic changes so much are sufficiently obvious. The effects of such variations are felt, indeed, in the best health; for the body is in some measure both a barometer and a thermometer; at all events, it is subject to the same influences, the lungs being in all cases the parts most affected. With the temperature moderately high and the air dry, the physiology of respiration is carried on easily and well. The amount of oxygen taken in is ample; the expiration of water, carbonic acid, and ammonia is free; the pulmonic circuit of the blood is unimpeded; the exhalation of water from the skin is unchecked; and the radiation of heat from the body is moderate. Let these atmospheric conditions suddenly change for those in which the temperature is 35°, or less, and in which the air is charged with watery vapour, and the conditions of life are materially modified. The supply of oxygen taken into the lungs is less; the process of absorption of such oxygen by the blood is less; the expired products are lessened; the pulmonic circulation is impeded; the watery exhalation from the skin is, in part, suppressed; the radiation of heat from the body is much more rapid; and, as a result of all, the whole man, body and mind, is enfeebled in force and in vitality. This is the course of things in a healthy man during atmospheric variations. It is left with the reader to trace out the exaggerated evil of these changes in those who, at the most favourable times, are existing with the lungs reduced in capaciousness and the respiratory muscles in power.

I shall recommend no particular place as a resort for consumptives; for I wish not to enter into disputation on this point. But here is the formula for an hypothetical Atlantis for consumptives. It should be near the sea coast, and sheltered from easterly winds; the soil should be dry; the drinking water pure; the mean temperature about 60°, with a range of not more than ten or fifteen degrees on either side. It is not easy to fix any degree of humidity; but extremes of dryness or of moisture are alike injurious. It is of importance in selecting a locality that the scenery should be enticing, so that the patient may be the more encouraged to spend his time out of doors in walking or riding exercise. A town where the residences are isolated and scattered about, and where drainage and cleanliness are attended to, is much preferable to one where the houses are closely packed, however small its population may be.

In speaking thus of the value of an equal climate, I am guided chiefly by the facts daily presented to me in relation to climatic variations on patients living in these islands. Some authors, however, infer from mortality returns, gathered from various quarters of the world, that variations of climate do not materially affect the disease, but that it is uniformly more fatal in cities than in the country. In England the excess in cities is equal to 25 per cent.

The facts are not opposed to the value of climatic uniformity. On the contrary, they prove the value;

for as consumption is most rare in extreme northern climates, and at great elevations, so in these localities are variations of climate less marked. It remains yet for statistics to show whether in the most favoured patches of earth, where, with the absence of climatic variations, there is a genial but temperate warmth, the disease is less prominent and less fatal.

RULE IV.

The dress of the consumptive patient should be adapted to equalise the temperature of the body, and so loose that it interferes in no way with the animal functions.

Instinctive sensations both in health and disease naturally dictate the above rule. But it is too commonly the fact that these sometimes are disobeyed. Some persons think it a hardy, and therefore a beneficial, plan to dress lightly in all weathers. Foolish mothers send out their children in midwinter with bare legs and chests ; young ladies go to balls and evening parties with the upper part of their light dresses open over the throat and bosom. Others go on a different tack ; they must at all seasons be smothered up in flannels and outer dresses, layer upon layer, carrying with the severest fatigue as much weight of cloth as they possibly can. Such persons on both sides evidently misunderstand the uses of clothes, or think them only ornamental appendages. Clothes are useful, in a sanitary point of view, simply as equalisers of temperature. Heat is transmitted slowly through flannel, so flannel is warm. For this reason, flannel which should be worn in winter is unnecessary in summer, unless it is of light and porous structure.

I speak here of the body in health. In the consumptive patient, the principle is modified. He, from the deficient play of his lungs, is virtually always living in winter; and we may find him on the hottest days breathing with anxiety, and with his hands and feet and brow cold.

For the consumptive, therefore, flannel clothing is always required, and it should cover the whole of the body. The thickness of flannel must vary according to the sensations; as far as is possible, the feeling of absolute cold ought to be at all times prevented. The consumptive should sleep also in flannel; not in the dress worn during the day, but in a flannel gown. The shoes worn should be lined with flannel.

A common practice in the selection of clothes is to imagine that the weight of a garment conveys an idea of its warmth-sustaining power. This is an absurd error, and for consumptive persons this mistake about heavy clothing must be carefully avoided. They may safely trust to flannel of so porous a texture that it can be breathed through without offering any appreciable obstacle to the breath, and they may then walk out as warm as they can be made by clothing, without the risk of being wearied from the burthen beyond their powers of endurance.

All absurdities in the way of hare skins, warm plaisters, and the like, placed specially on the chest, are useless; and the plaister is worse than useless, since it checks the function of the skin over a considerable surface, and is soon dirty.

There is one modern article of attire on which a word of caution must be said, because its bad effects are unmistakable. I must warn all, but the consumptive in particular, against wearing what are called waterproof India rubber coats. The healthy man may tolerate one of these garments; the consumptive, never.

It loads the under-clothes with moisture; it gives a cold envelope to the surface; it produces chill; and, by checking the cutaneous function, it throws a double amount of work on lungs already failing under their ordinary duties.

Is it necessary to more than condemn those abominations of female attire, corsets? I hope not. But not less injurious than the corset is the practice of placing a strap or belt round the waist, tightly buckled. In the old times, the ascetics wore the tight strap as a penance for sin. This was surely the true and original function of the article. Now it is a penance worn for society in a foolish mood.

RULE V.

The hours of rest of the consumptive patient should be regulated mainly by the absence of the sun.

If exercise is important to the consumptive patient during the day, a due allowance of sleep is equally necessary during the night. The natural hours of sleep are from sunset to sunrise, and it is the business of the consumptive to make nature his oracle. Shakespeare has happily said that sleep is the "chief nourisher of life's feast," and Menander held that it was "a remedy for every curable disease." The great use of sleep truly is to renovate; for in the sleeping state the formative processes go on most actively. Metcalfe has well defined the difference between exercise and sleep by saying "that during exercise the expenditure of the body exceeds the income; whereas during sleep the income exceeds the expenditure."

It is obvious that to the consumptive person nothing can be more important than that the income should alternately and at natural seasons exceed the expenditure; and it is quite remarkable how much alleviated all the symptoms of consumption are when sleep is ensured. The rule I have laid down regarding the hours for sleep is imperative for many reasons. First, because in all seasons the actual amount of rest required by the natural man is pointed out by the course of the sun. Secondly, because to extend the day by artificial lights, making a little sun out of a gas lamp or candle, is to feed that lamp with a part of the breathing store of the air, and vitiate the atmosphere. Thirdly, because, though artificial light is injurious, the pure sunlight is, on the contrary, of the greatest worth in the acts of vitality.

Thus, to fulfil the natural law regulating the times of sleep, to escape from the artificial light, and to obtain the advantage of all the sun-light that can be secured, the consumptive patient should make the sun his fellow workman.

As soon as the patient has risen, he should at once leave his bedroom; and, if the morning be fine, he should go into the open air. On this point Mr. Bodington, in a short essay "On the Treatment and Cure of Pulmonary Consumption," published in 1840, dwells with great force. "The profuse nocturnal perspirations are soon subdued," says Mr. Bodington, "by this method of treatment, and the debility they occasion avoided. The skin assumes a healthier action in proportion to the extent of exposure to the external atmosphere, particularly to the morning air."

In large towns the practicability of this last suggestion is less than in the country; but even in London life, an early morning walk should be made a matter of strict business by the consumptive. On a fine summer morning, between four and five o'clock, a walk through the streets and squares of London is, indeed, a treat which few Londoners understand. The air is free of smoke; the thoroughfares are royal unimpeded highways; and, while the great population sleeps, the magnitude of its residence is best seen and understood.

RULE VI.

The occupation of the consumptive patient should be suspended if it is in-door or sedentary; but a certain amount of out-door occupation may be advantageous.

This rule is often difficult to carry out. At the same time it is second to none in importance, as there is, in a word, no exciting cause of consumption so general as in-door occupation. I remarked that about two out of every three patients with consumption, who presented themselves before me at the Royal Infirmary, were employed in some in-door business. This was confirmed accurately by reference to the Infirmary books, the figures of which were very carefully analysed for me by Mr. Pring, a student and assistant at the institution.

Out of five hundred and fifteen cases of consumption, not less than 68·34 per cent., or rather more than two-thirds, were persons following in-door occupations. Possibly the percentage was even higher, for all who called themselves labourers were presumed to be out-door workers. Among the in-door occupations which presented the largest number of cases in this list, boot and shoemakers ranked first; needlewomen second; watch and clock-makers third; domestic servants fourth; painters fifth; tailors sixth; printers, of whom the majority were compositors, seventh; bookbinders eighth; French polishers ninth; cigar-makers tenth;

writers eleventh; smiths twelfth; tin-men thirteenth; and cabinet-makers fourteenth. There were, altogether, in the list one hundred and forty trades specified, but the above-named fourteen yielded rather more than forty-four and a-half per cent. of the whole.

In the case of parents having children of a consumptive tendency, the greatest care should be taken to obtain for them out-door employment. But here a serious delusion commonly comes into play. If the child is weakly, the anxious parent urges that it is unfit for hard labour and for out-door vicissitudes; so it is sent to a place where it will not be exposed to cold or hard muscular work, like a draper's shop, or to some occupation of an in-door character. By this grand, ignorant, and fatal mistake, many victims are added to the list of the phthisical class of the community.

In many in-door occupations a double mischief is at work. The patient is not only confined in an impure air, but is made also to inhale some foreign agent, present of necessity from the character of his work, and with which the air is charged.

Some sedentary occupations beget a habit of muscular inactivity. Unworked machinery always resumes work lazily, and muscles long left to a passive nutrition respond slowly to the dictation of the will. The physical inertia conquers the mental powers. Hence some patients cannot be persuaded to give up their inactive pursuits, even when they have the opportunity. To prescribe to these individuals a walk of two miles per day is felt as a cruelty. Nor are these difficulties met with only in anæmic young girls, bleaching in millinery establishments, or in no establishments at all. They extend to men of various sorts: to men of letters, to men given up to sheer indolence, and to sedentary workmen, such as watchmakers, shoemakers, and tailors.

On the other side, almost all occupations implying muscular exertion out of doors, without undue exposure to wet and damp, may be pursued by the consumptive as long as possible, and with advantage. Work keeps the mind occupied and in healthful tune.

I remember a patient once who, in the first stage of consumption, insisted on coming into town each morning from a considerable distance in the country, to look after his business, and to return home again in the afternoon. It mattered not that the sky looked threatening, for he was not afraid of such a trifle, although he thoroughly knew his critical condition. When expostulated with by his advisers (and, I am ashamed to say, by myself, for I was ignorant then of the truths I now state), his reply was, "My brothers and sisters have all died of consumption; they were coddled up, nursed, carried about, confined to bed, and bound in the cords of helplessness by the kindest hands, to the satisfaction of the doctor and of all concerned. But they soon died. I inherit the proclivity to the same disease, and I too shall die; I know it; but my course is different, for I have made up my mind to die in harness; I have kept at my business in resistance to all entreaties, and I am the only one of the family left." The plan adopted by this man was right; he bore the brunt of the disease for months, and is alive and occupied still.

I recommend all in whom consumption is hereditary, whose occupation is in the open air, to take to heart the motto of this man, to make up their minds "to die in harness." They will live the longer for the resolution.

At the same time, as there is a medium in all things, so is there in work and exercise. Excessive and violent muscular fatigue is next door in injuriousness to complete muscular inactivity; and it is remarkable, in looking over tables of the occupations of consumptives, to find that amongst those who are reported to have been occupied in out-door work, the majority have belonged to pursuits which imply an *extraordinary* muscular expenditure.

RULE VII.

Excessive mental exertion should be avoided by the consumptive.

It is the fate of some members of the human family, who are of consumptive taint, to have minds of a very active and laborious character. As children, these love reading, and pursuits of an intellectual kind. They are specially precocious; and admiring parents, with proud hopes as to the future of their offspring, encourage an exertion which ought ever to be kept in bounds. As these precocities grow up, their mental development runs out of proportion to the development of the body. On this, muscular labour becomes a bore, and the study or desk the only enjoyable place in life. The result is, not that the mind by its overwork directly wears out the body, but that the body is neglected, and its physical degeneration hastened.

The bad effects show themselves first, according to my observation, in derangement of the digestive system. In young persons of consumptive taint, the impaired nutrition of the whole body, incident to the impaired digestion and broken sleep, tells speedily on the respiration, and supplies the first link in the fatal disease. Let all the absurd poetry about "those dying young whom the gods love" go its way. The gods love and help those who live naturally—and these die *old*.

I have seen so much mischief arise from the overwork of the mind, in consumptive children and youths, that I have dwelt no longer than is really necessary in treating on the importance of the present rule. If I had a child of decidedly consumptive tendency, he should scarcely touch books at all. He should be taught orally as much as possible; he should be brought up in the open air, and to out-door pursuits and occupations; and he should be encouraged to enter into every innocent game where the muscles are brought into vigorous play.

The choice of an occupation is best made by adopting the exclusion process. Exclude every calling in which close confinement to the study, the shop, the counting-house, or any other house, absorbs the greater part of life. The agricultural life is, on the whole, the best.

Every occupation will be modified with advantage by the enjoyment of ennobling pleasures. The dance, the lecture, the drama, music, is each good in its season, when attainable without injury to health. But from all crowded assemblies I warn the consumptive to keep away. The pleasure derived from them is nothing in comparison to the evil insured in obtaining it.

Music has a grand influence on some minds, and may be cultivated with advantage under due regulations; but upon wind instruments the phthisical man should not exert his skill. The exertion of blowing these instruments interferes materially with the regular play of the respiration and circulation. In playing upon stringed instruments, moreover, the amusement should not be carried on until it wearies the performer. Mothers anxious for the accomplishments of their daughters make frequently a fatal mistake on this score.

They place a poor child, who has no musical tastes, at the pianoforte ; and there she is made to sit hour after hour, until a lesson is perforce learned, or an exercise completed. The system, useless in an educational sense, is fraught with direct danger to health.

For the consumptive, reading aloud is a good daily practice. Cuvier, the great naturalist, attributed his recovery from threatened phthisis to the delivery of some lectures which he was appointed to give. There should, of course, be a limit to the time of reading aloud ; it should never exceed an hour, should be stopped if hoarseness or weariness occur, and should be without effort or vociferation.

The selection of books for the entertainment of the mind is a further and important point. Exciting romances, filled with the narrations of deep and fiendish plots or hyper-poetic sentiments, are quite out of place, for they, through the mind, influence respiration to the detriment of the physical forces of life. So also do dull, monotonous, whining, terror-striking treatises, of whatever kind. But the book which is amusing, and which, with easy effort, raises the hearty laugh at an innocent picture ; or the book which carries the reader along the page of history with gentle carriage, or tells of natural facts in natural language,—this is the book to be sought for.

Singing is an amusement which may with prudence be followed by the consumptive in whom the tendency to the disease is indicated only, and the disease itself is not actually developed. The exertion must not, however, be kept up so long at any given time as to produce breathlessness or hoarseness. It must be done without labour or distress, and at intervals when the body is in a condition to sustain the effort. It is then useful.

To sum up, the amusements of the consumptive should combine with the pleasure they afford a moderate and equal degree of muscular exercise, and with the muscular exercise a degree of exhilarating amusement free from overexcitement and mental toil.

RULE VIII.

Cleanliness of body is a special point in the treatment of consumption.

But little need be said to enforce this rule. In health there is always a mutual understanding and a kind of partnership between the skin and lungs. In consumption moderate action of the skin is a relief to the lungs, and as such ought to be encouraged. This is best attained by keeping the skin clean by daily ablution. Let the consumptive boldly take his bath as each morning comes; not a shower bath, not a cold bath, under any impression that water cast on the body in a certain fashion, or at a certain temperature, will give strength, but a tepid cleansing bath, with the temperature from five to ten degrees below that of the body. There is no occasion to stay in the bath a moment longer than to obtain a free ablution; then the patient should rapidly but effectually dry himself all over with a rough towel, and dress with the flannel garment undermost.

The clothes of the patient should be scrupulously clean; the underclothing should be changed every day.

RULE IX.

Abstinence from all habits of gross sensual indulgence is an essential part both in the prevention and the cure of consumption.

I need not particularise the vicious sensual indulgences to which many of humankind habituate themselves; for as suggestive descriptions are better left unwritten for those who are ignorant of sensual indulgences, so for them who require to be forewarned no such descriptions are demanded, since they know too much already. In a word, I should say that the grosser the sensuality indulged in, the greater is the physical evil resulting from it. Let the consumptive, at least, bethink themselves what vices affect and prostrate most, and then with strong mind and will give them up altogether.

To those who have charge of the young, no duty is so imperative as that of carefully watching over the physical interests. Let these make it their first care to prevent the tendency to sensual debasement. In large schools, a little attention and firmness on the part of teachers and governors, with the assistance of medical supervision, would obviate a host of life-long evils.

RULE X.

The diet of consumptive patients should be ample, and should contain a larger proportion of the respiratory constituents of food than is required in health.

The appetite of consumptive patients is very capricious, and daily grows more so if it be not sharpened up by exercise. When the food taken is not applied to the purposes of nutrition, it is better left untasted; for otherwise it lies undigested in the alimentary canal, and sets up a serious train of dyspeptic symptoms, nausea, and diarrhœa. Kind friends often, with the most provoking and mistaken good-nature, thrust upon the consumptive relays of the most improper food, because the necessity for nourishment is so obvious. But the fact is that, when the lungs are acting indifferently, digestion cannot go on actively, since, as Arbuthnot well observed, respiration is "the second digestion." Hence the quantity of food taken by the consumptive person should be small at each meal; but the meals may, if the sensations of the patient require it, be more frequent than in health. Of animal foods, mutton is the best. Fatty and oily foods, which constitute the respiratory class, should predominate, and fresh butter, with bread, may be taken almost *ad libitum*, so long as it agrees with the stomach. Cream, too, is excellent, and the luxury of curds and cream is very suitable. Milk, whenever it suits, is advisable as a constant drink food, and good cows' milk, new, answers every purpose. There are, as far as I can gather from numerous cases in which I have seen them tried, no such specific virtues in asses' milk and goats' milk as some have supposed. Tea may be taken, in moderation, with perfect safety. Fresh vegetable diets should not be omitted; and fruits, especially roasted apples, are always admissible, except in instances where they excite irregular action of the bowels. The Iceland moss has had a great reputation, as have jellies of different kinds, but these often are slow in digestion, and they have no specific value.

The question of the use of alcohol in consumption is one on which scientific opinion is much divided. I have recommended alcohol under some conditions of the disease, and I have shown, on the other hand, that one particular kind of consumption may be produced by indulgence in alcohol. Of late years I have prescribed alcohol very sparingly, and never in the form of the pernicious mixtures in which it is sold for general use under the names and forms of alcoholic beverages. When I now prescribe it, it is purely as a medicine and in the form of alcohol itself properly measured, properly diluted, and properly timed. In this form it comes under the head of medicinal, as distinguished from hygienic, treatment, and, I am satisfied, with much more value than when it is inaccurately classified as a food or drink.

The two indulgences snuff-taking and tobacco-smoking ought to be strictly avoided by the consumptive.

Reviewing what has been thus written, I would add as a supplement to the ten rules submitted, that, whenever distinct evidences of phthisis have set in in an individual of either sex, the marriage of such person is wrong, if not inexcusable ; while the marriage of two persons, both the victims of the disease, is opposed both to reason and humanity.

CONCLUDING NOTE.

The above essay "On the Hygienic Treatment of Pulmonary Consumption"—less one or two minor revisions—was written and published under the same title in 1856.

The essay found little favour. It was considered as not practical, and as conveying the ideas of a dreamer, that the fatal disease, consumption, could be prevented generally, and treated specially by hygienic measures. To-day, under a revival of the old animalcular speculation as to the origin of some diseases from living forms—the entity doctrine in a new dress,—the conception of the hygienic treatment of pulmonary consumption has been accepted in name as well as practice, as if it were new in word and in deed, the height of practical learning and skill. So ideas change ; and the disfavoured of one generation is the favoured of another. But it matters not how or by whom it is borne, so long as the torchlight of truth makes its way.

MEASURES OF VITAL TENACITY.

IN the observations which I have made on animals passing into death by the lethal process, nothing has impressed me more than the curious differences of vitality or vital values of different animals. The differences are so great they seem almost inexplicable, and in many respects they are so. To some extent, however, they come under law, and we may therefore hope that by carefully continued research what is now difficult and involved may be rendered, in time, simple and perfectly clear.

The first series of observed facts relate to vital differences in animals of different species. In illustration I may take the cat and the dog. Between these animals the distinction of vitality exists irrespectively of age, and of all other conditions and circumstances of which I can gather information.

Of the cat it is commonly said that it has nine lives. By this saying nothing very definite is meant beyond the opinion that under various kinds of death the cat lives much longer than other animals that have to be killed by violent means. When any question is asked of the police or of other persons who have to take the lives of lower animals, they tell you, without exception, according to my experience, that the cat is the most difficult to destroy of all domestic animals, and that it endures accidental blows and falls with an impunity that is quite a distinguishing characteristic.

The general impression conveyed in these views is strictly correct up to a certain and well-marked degree. By the lethal death, the value of the life of the cat is found to be, at the least, three times the worth of the dog. In all the cases I have seen in which the exactest comparisons were made, the cat outlived the dog. A cat and dog of the same ages being placed in a lethal chamber, the cat may, with perfect certainty, be predicted to outlive the dog. The lethal chamber being large enough to hold both the cat and the dog, the vapour inhaled by the animals being the same, with every other condition identical, this result, as an experimental truth, may be accepted without cavil.

The differences, always well marked, are sometimes much longer than would be credible in the absence of the evidence. I have once seen a cat, falling asleep in a lethal chamber in the same period as a dog, remain breathing, literally, nine times longer, for the dog died within five minutes, and the cat not only continued to breathe, in profoundest sleep, for forty-five minutes, but would have been recoverable by simple removal from the vapour into fresh air if it had been removed while yet one act of breathing continued. This, however, was exceptional, because the cat in the same lethal atmosphere as the dog does not, as a rule, live more than thrice as long; *i.e.*, if the dog ceases to breathe in four minutes, the cat will cease in from ten to twelve minutes after falling asleep.

The character of the vapour used does not make any difference, relatively. Carbonic oxide, carbonic acid, chloroform vapour, carbon bisulphide vapour, yield the same relative results. Pure carbonic oxide kills with intense rapidity, but it kills the cat less quickly than the dog. If instead of a lethal vapour prussic acid be used, in administration by the mouth, the cat dies more slowly than the dog. The same is true in respect to death by drowning.

Still more curiously, recovery from apparent death is much more frequent in the cat than in other domestic animals. Mr. Warrington once observed a cat recover from apparent absolute death by prussic acid, eight hours after it had lain as if dead. I once saw a young cat come back to life after two hours of immersion under cold water.

I do not know many facts bearing on tenacity of life in other animals, but I have observed that sheep in a lethal atmosphere die very rapidly, goats much less rapidly, and pigeons more rapidly than common fowls. There is, apparently, a specific tenacity in all species.

In animals of the same species there are distinctions determinable by peculiarities in the animal itself. In one instance where a large number of dogs were put to sleep in the lethal chamber, one was found in deepest sleep, but still breathing, side by side and partly covered by another that was not only dead but cold and rigid. A similar fact occurred last year in the human subject in a mine. A father and son killed by fire damp lay together, the father dead, the son living, though he, the son, had come first under the influence of the lethal gas. In all the fatal accidents to the human subject from the administration of chloroform or other narcotic vapour we see the same illustration. I doubt whether in any one of these unhappy events the death has been induced by what would be, under the common run of administrations, a fatal dose. But some die from a dose that would not so much as narcotise others. An analogous series of facts is met with in relation to the effects of physical and mental shocks and to surgical operations.

The variation of measure of tenacity of life is unquestionable. What is the reason of it? What is there in one species of animal that gives a measure of tenacity over another? Why, for instance, is the cat more tenacious of life than the dog?

The only answer as yet is, that the cat is endowed with more vitality. But this is no answer as to details. Is the endowment of the greater vitality centred in the nervous system, in the muscular, in the respiratory, in the blood, in the membranes?

And wherever centred, what is the endowment?

The difference of tenacity in animals of the same species is more approachable because we know certain factors that afford an explanation of it.

Age is a factor. In the young the tenacity is more distinctly marked than in the old. In a broad sense there is no exception to this rule.

Degenerations of tissues are factors. Fatty degenerations are reducers of tenacity. Lessened arterial tension is a reducer.

Race or breed is another factor. The strong wiry muscular animal of any species is more tenacious of life than the heavier and less elastic. The terrier outlives the spaniel or retriever. The man of sanguine temperament outlives the nervous and lymphatic man.

In the operation of tracheotomy for croup or diphtheria in children, other things being equal, the chances of a successful issue will be as two to one to a spare active wiry subject compared with the chances of the full-cheeked, full-bodied child with luscious lips and rich flowing curls of pale or golden hue. The first of these will live almost through the gate of death; the second will succumb without a struggle for life.

Will is a factor. I have twice seen tenacity of life maintained, as it were, against all possibilities by what is called the will of the sufferer. Mr. F. Hall, of Jermyn Street, had a patient in the last stage of pulmonary consumption, whom I had seen with him in what appeared to be a condition of emaciation and exhaustion that precluded the feeblest effort towards rising from bed. Yet one day, and three weeks only before actual death, this sick man by a supreme effort of volition rose, dressed himself, went out of his house, and had to be sought for by his friends and brought back, with gentle compulsion, simply to die.

A young authoress of great promise, suffering from the same disease,—pulmonary consumption,—in the very last days of her life rose from bed, and in the most vigorous style was engaged for several hours in composition on letters and work which had been for months laid aside. Her friends, bewildered by the phenomenon, could scarcely accredit that the effort did not presage recovery, until rapid collapse dispelled the illusion.

This tenacity of life illustrated through volition is the equivalent of that courageous endurance which some in famine and war have "miraculously" exhibited.

These examples illustrate the influence of certain factors on tenacity of life, and they may, one day, lead up to the prime cause of the difference of tenacity if they and other facts bearing on the matter be carefully observed and recorded. But, as yet, the prime cause remains a troubled and troublous question.

VESALIUS, AND THE BIRTH OF ANATOMY.

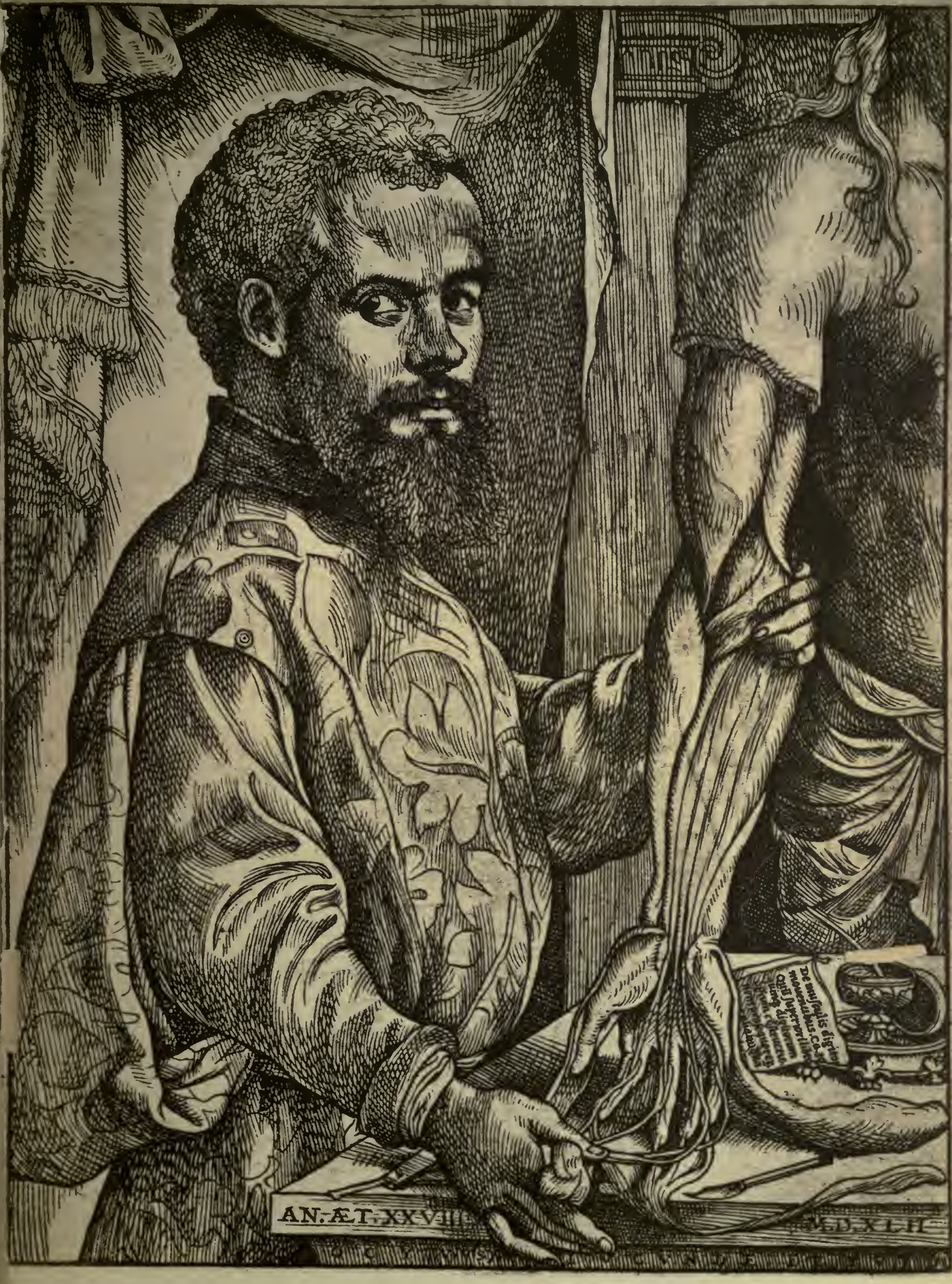
THE STUDENT.

THE title, *Father of Anatomy*, applied so often to Andrew Vesalius, is and is not deserved. Vesalius was not the father of anatomy, and yet it is very doubtful if any great and immediate advance in anatomy would have been made in the sixteenth century unless he had lived and laboured. The combinations of physical and mental qualities which met in this man were as rare as they were remarkable and potent. They were what were precisely wanted for the great task, a task as hazardous as it was momentous.

Vesalius was, physically, of perfect cast. His strength was linked with activity,—always a happy blending. He must have had the strength of manhood while yet in his adolescence. His mental activity ran in richest vein. He was an artist, a handicraftsman, a writer, an observer of nature, a maker of history. He was courageous, calm, self-contained, incessantly industrious.

His gifts—his mental gifts at any rate—were gifts descending to him. In this sense he was what we now call a Galtonian study, like the last Darwin. His great-grandfather, John Vesalius, was a learned

ANDREAE VESALII.



Portrait of Vesalius (Frontispiece)
Fac simile from Vellum Edition
of "Epitome de Humani Corporis Fabrica
See page 150. Asclepiad II. 1885

Autograph of Vesalius

Andr. Vesalius

Fac simile from Burggraeve's
Etudes. Copied from
Sir William Stirling Maxwell's
Edition (1874) of Tabulæ
Anatomicæ.

BWR

London April 15th.
1885.

physician—physician to Mary of Burgundy, the first wife of Maximilian the First. His grandfather, Everard Vesalius, also a physician, was a scholar and classic, translator of some parts of the works of Hippocrates, Galen, and Rhazes, and thereby a celebrity. His father, Andrew Vesalius, apothecary to Margaret of Austria and to Charles V., was of honourable repute.

The family name, originally, was Wittings, but for some generations before the birth of the anatomist, the name of Wesele, or Vesele, had been assumed by them, after a small town of that name in the Duchy of Cleve, which they claimed as their native place.

Our Vesalius, Andrew by Christian name, was born on the last day of the year 1514, in Brussels. His earliest tastes were for anatomy and the dissection of lower animals. For what else he was in youth distinguished we have no record, but so soon as the years of boyhood were passed in the University of Louvain, he was, after a season at Montpelier, in Paris studying human anatomy under Sylvius, at that time the light of his age, and still a light, through his researches on the brain, by which he is ever identified.

THE ANATOMIST.

After the close of his studentship, shortened probably by the commencing jealousy of Sylvius and the school he had founded, our Vesalius returned to Louvain. Here he became an anatomist, admired and feared, adventurous and resolute. On a gibbet outside the little university town hung the remains of a malefactor. The temptation was too great for the ardent Vesalius, full of youth, energy, and scientific zeal. He, therefore, aided by another student, must needs rob the gibbet of its treasure,—bones that had been picked clean by the birds and blackened by the sun. To remove the bones of the limbs was not difficult, but the iron shackles binding the trunk to the gibbet were obstinate. So the students, after the gates of the town were closed, remained out all night to complete their task. At last, when they had the prize in their possession, the question arose what they should do with it, for carry it into Louvain they dare not. So they buried it wholesale, afterwards removed it piecemeal, fitted it together in secret, and brought it forth as a purchase from Paris.

From Louvain Vesalius travelled into Italy, keeping anatomy always first in sight as the study of his life. Finally, after serving for a time as an army surgeon, and taking part in the campaigns of the Low Countries and in France, he settled at Padua, a professor in his twenty-fourth year, and, in the great school of medicine there, taught his favourite art from 1537 to 1544.

It is probable that Vesalius left Paris about the year 1533-4. He had already commenced the study of his immortal work, on the fabric of the human body; indeed, it has been said that in Paris itself, and under the very eyes of Sylvius, the project had its birth. However this may be, it began, it continued, it grew into perfection, and in the year 1542-3, after three years of close application to it, it saw the light, published under the title "De Humani Corporis Fabrica."

The great work was heralded by the publication of six plates of anatomy, Tabulæ Anatomicæ, in 1538. They were prepared and issued for the use of students, and were largely sold. They are numbered as follows.

1. The portal system and organs of generation.
2. The Venæ Cavæ and chief veins.

3. The Great Artery—Arteria Magna—and Heart.
4. The skeleton in its anterior view.
5. The skeleton in its side view.
6. The skeleton in its posterior view.

The work was dedicated to Narcissus of Parthenope, "the model physician of the time." This was Narciso Verdunno, first physician to the crown of Naples in 1520, and in 1524 first physician and councillor to the Emperor. The plates were drawn by an artist to whom reference will again be made, John Stephan de Calcar. As a frontispiece to the plates, drawn probably by the same artist, there is a picture of Vesalius giving a demonstration, to a host of strange-looking admiring pupils, from the dissected body of a woman.*

At a bound, "De Humani Corporis Fabrica" stood forth the foundation of Human Anatomy. For admiration, for criticism, for learning, three subjects were thrown open to admirers, critics, scholars. There were the dissections, there was the text, and there were the plates. These vied with each other. Well might Sylvius rave, and his pupils glow with jealous rage.

It is my intention a little further on to put forward a brief description of this famous volume. Before doing so, it will be but honest to indicate what were the objections made to it by the enemies of its author.

The opposition was not much divided. There were few, if any, who denied the greatness of the effort, but there were many who united in denouncing it as stolen light, stolen with ungenerous concealment of its prime sources, or, with still worse conduct, ungenerous reference to and scorn of masters who had previously struck the light and held it up to the stealer. Let us see to whose fame Vesalius was thus sacrificed.

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* My late friend Sir William Stirling Maxwell republished, in 1874, a fine edition of the work "Tabulæ Anatomicæ" with the frontispiece. The volume was intended for private circulation only, but a presentation copy will be found in the Library of the British Museum.

To Sylvius some have given the palm. Sylvius was noted for oddity as well as for science. He was a miser—" avarice itself"—and as such the hero of many tales and jokes. It is told of him that he fed his servants on dry bread, would never allow a fire, and in cold weather, instead of throwing wood on his hearth to burn and make warmth for his body, he would play at football, or take a large log, throw it over his shoulder, and run about with it in the open air in order to obtain animal warmth, and save the cost of fuel. Once, but once only, was he known to seem hilarious, and when his friends wondered much why such a fit should seize him, he explained the reason. He had dismissed his " three beasts, his mule, his cat, and his maid." To such a man, tenacious of all that belonged to him, mentally and physically, young Vesalius would necessarily be very troublesome, and as Sylvius determined to remain the master, a school of pupils, springing from him, arose to declare the order of the master and to denounce the pretensions of the new and youthful professor.

Eustachius has been brought into comparison with Vesalius. It was asserted by the opponents of Vesalius that Eustachius prepared an anatomical work, which, illustrated by copper-plates, surpassed all that had gone before. But where was this work? It was lost. It was lost for one hundred and thirty-eight years after the death of its author. It turned up in the year 1712; Eustachius died in 1574.

Fallopius has been set off against Vesalius, and his position in the great school of Padua gave a fair colour to the suggestion. The character of this man, blameless, industrious, learned, and beloved, intensified the partisan admiration for him and his fame.

It would be useless to adduce any other lesser contemporary names connected with this controversy, and it would be unfair to Vesalius to permit those I have named to stand on his level. They were all great in their way, but their greatness, compared with his, lay, if I may so express it, in its lesserness. They were conspicuous for the close attention they paid to particular parts, Sylvius to the brain, Eustachius to the organs of sense, Fallopius to the uterus and its appendages; and from their special studies in these particular directions they connected their names so intimately with the parts they dissected and described, that their names have become, like the parts themselves, one and the same in literature :—"the fissure of Sylvius;" "the Eustachian canal;" "the Fallopian tube."

But compared with Vesalius, who can scarcely be said to have left his name specially connected with any organ or structure, these anatomists are of secondary constellation. Vesalius left his name with the whole fabric of the human body.

Two other men, whose names cannot be omitted, remain as men who share with Vesalius in fame, and in them his enemies had a cause which, although rather unfairly enforced, was of weight and consequence. These two men were Mondinus and Galen.

Mondinus, nearest in point of time to Vesalius, being a little more than a century before him, set the world at defiance by dissecting the bodies of the human dead, and by describing the dissections. In 1306 Mondinus dissected a human body; in 1315 he dissected the bodies of two women, and he published a work, with illustrations, which up to Vesalius was the text-book, the *vade mecum* of all the schools in which anatomy was taught, and of all the professors of the art.

Mondinus deserves a separate history, but here he can only be named in this casual manner. He opened the narrow way which Vesalius transformed into the highway of anatomy.

The other anatomist, much further back than Mondinus, was the man of the magic name—Galen, the second father of physic after Hippocrates. Him the opposing contemporaries of Vesalius were loud to extol as one from whom the modern upstart had stolen without recognition. The seventeen golden Galenic books, "De Usu Partium," were put forward as the fountain heads of the Vesalian labours. The description of the human hand in the first and second of these Galenic books; the description of the difference in the foot of the ape and the foot of man; the description of the brain and nerves; these and many other details were adduced to indicate that Galen had dissected the human body, had defined the parts with scientific precision, and had afforded Vesalius the groundwork of all his studies and their results.

I do not think we ought to deny to Galen that he helped Vesalius: as well deny to Aristotle that he helped Galen. But in spite of all we may claim for Vesalius the title of Father of Anatomy, in the sense that before him there was no compact science, no model, truly no book of anatomy. It is easily to be conceded that Vesalius, in his early student life, had, to the best of his ability, made himself master of all that had gone before him. Upon that learning he rested, systematized, and progressed. From that learning he dissected the human body as no man before had done.

In these remote days, with all passion on the Vesalian controversy over and long buried, we may admit much that the foes of Vesalius said, while we still recognise in him the Father of Anatomy, whose genius was incomparable industry, and who wrote his own immortality in the immortal work to which it is now time to turn for brief study.

"DE HUMANI CORPORIS FABRICA."

The work first appeared in 1543. It was printed at Basle by the famous John Oporinus, printer and professor of Greek there. The copy I am writing from, in most perfect condition—lent me by my learned brother Henry Stevens, F.S.A., of Vermont—is the German edition—Nuremberg, "Anno Salutis, MDLI.," with copies in full of the original plates, models of artistic skill.

Giving all the credit of the dissections to Vesalius, the first thought that occurs is, Who was the artist who made the drawings from the dissections?

It has been supposed that no less a hand than that of Titian worked here for Vesalius, but not a line is left, as a name, to prove the suspicion. Still it might be correct. Titian and Vesalius were friends. Titian, who was thirty-six years older than Vesalius, and who survived him thirteen years, must have known all the Vesalian family connected with the courts of the Emperors Charles and Philip—the grandfather, John Vesalius, and the father, Andrew. He, therefore, would know our Andrew all through his short and brilliant career. It seems also to be generally accepted that the plates came from the studio of Titian. Lastly, they are in every way worthy the hand of that master.

Horatio, the versatile youngest son of Titian, who from painter, all but equal to his sire, was charmed away from art by the Philosopher's Stone, has been accredited with the honour of being the delineator for Vesalius. A brother of Titian, who after kindling jealousy in the heart of the master toned down to an ebony carver, has received the same honour. Lastly, to John Stephan de Calcar, whose portrait of Vesalius is one of the treasures of the Royal College of Physicians, who was so matchless a pupil of Titian that the works of master and pupil are apt to be confounded, and who certainly drew the Tabulæ Anatomicæ, because his name is on them, has been assigned the distinction. On the whole, the evidence is in favour of the view that John Stephan was the designer and perhaps engraver. He was the friend of Vesalius, and, like the ancestors of the anatomist, born in the Duchy of Cleve, was "a Fleming," ranking, as Vesalius describes him, "with the divine and happy wits of Italy."

Whoever was the delineator, he was the equal, in his way, of Vesalius himself. There had been nothing before like this art in anatomy; there has been nothing to surpass it since. Unconsciously, almost, the plates have been copied from then to our day. Old Helkiah Crookes, or Crocus, writing in London, in the year 1615, a big volume on anatomy—printed by W. Jaggard, printer of the first edition of Shakespeare's plays—sneers at Vesalius as a copyist from Galen, and then copies Vesalius from the beginning to the end of his volume. Rascally Crocus!

The plates stand any inspection. I have had them all photographed on glass, in order to throw them on the screen with the oxy-hydrogen light, magnified to the full natural size. They bear the test well. In February last, at the Birkbeck Institution, I put them, thus enlarged, before an audience, who saw them with a wonder which Vesalius himself never enjoyed. Some listeners to my lecture told me afterwards "it was like looking at the dissected body transparent," and as far as the plates were concerned they were right.

The work altogether, indeed, may be most conveniently studied and described from the plates.

The series opens with the skeleton, each bone depicted with exquisite fidelity. The anatomist prided himself on his knowledge of the bones. Once in Paris he allowed himself to be tested. He was closely blindfolded. Then every bone of the body that could be distinguished by the touch was put into his hands, and by the sense of touch he was able to name every bone correctly, and tell its position in the skeleton,—to his questioners a wonderful exhibition of knowledge and skill. Blindman's-buff with dead man's bones!

On another occasion, in 1546, at Basle, he fitted up a skeleton entire, and presented it to the authorities of the University. Above the gift was engraved the following:—

Andreas Vesalius. Bruxellen.
Caroli v. Aug. Archiatrus.
Laudatiss. Anatomicarum.
Administr. Comm.
In Hac Urbe Regia
Publicaturus
Virile quod cernis sceleton,
Artis et industriæ suæ
Specimen.
Anno Christiano
MDXLVI.
Exhibuit Erexitque.

The illustrations of the osseous are followed by those of the muscular system, and are equally fine. The views of the superficial layers of muscles have since been made familiar to us in almost every illustrated work on anatomy, in almost every cast in every studio. The well-known profile view, which the public usually refer to as "the man running away without his skin," is one of this group of Vesalian treasures. The views of the superficial layers of muscles are followed by the deep layers, illustrations not so agreeable to the eye, but wonderfully accurate. The different muscular organs are drawn to indicate function, as well as structure.

From the osseous and muscular to the respiratory and circulatory systems is another step in this wonderful gallery. The whole of the arterial system and of the venous system is delineated in separate plates, and to them is added another plate, in which the two systems of vessels, arteries and veins, run together in their natural order. In other plates follow special circulations:—the circulation of the brain; the portal circulation,—a plate of surpassing character,—and the pulmonary circulation in two views. In a small series of plates the anatomy of the heart is represented.

To convey to the reader who may not have the volume of Vesalius by his side some idea of these illustrations, Bertram Richardson has copied a few of them precisely as they appear in the volume.

Fig. 1 shows the pulmonary circuit from its anterior aspect, with the heart dissected away.

Fig. 2 shows the left ventricle and its valves.

Fig. 3 shows the aorta laid open at its origin and its semilunar valves.

Fig. 4 shows the tricuspid and mitral valves when

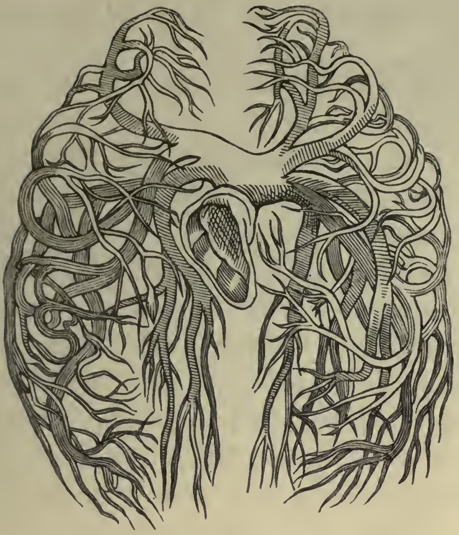

FIG. 1.

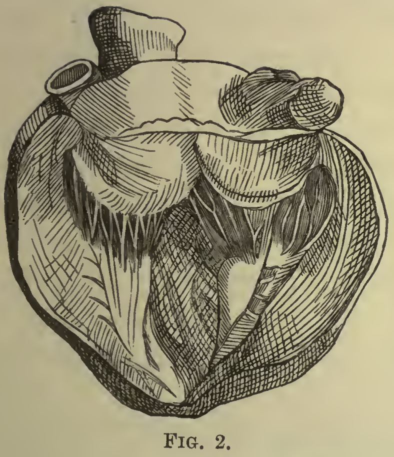

FIG. 2.

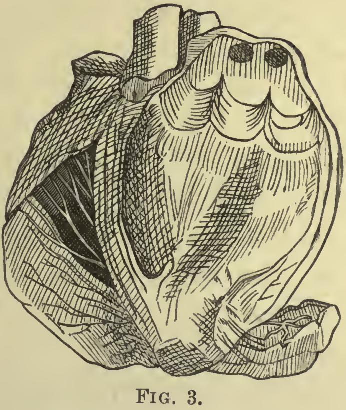

FIG. 3.

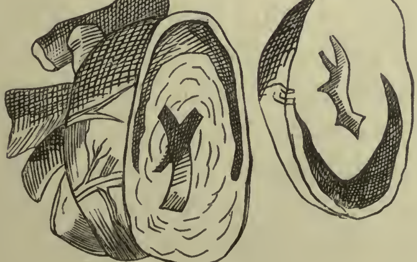

FIG. 4.

they are closed and made tense by fluid pressure from below.

From the mode in which the last drawing is carried out I have little doubt but that the valves were floated up, as in the modern class-room experiment, by filling the ventricles with water until the valves became sufficiently raised and tense to close.

The illustrations of the nervous system equal, if they do not even surpass, those of the osseous, muscular, and circulatory. The position of the brain within the cranium; the membranes which cover the brain; the sections of the cerebral matter; the cerebral cavities; the divisions of cerebrum, cerebellum, and medulla; the base of the brain; the origin of the cerebral nerves; the distribution of the nerves; the spinal cord, and the commencing ramifications of the *par vagum*, form a series or gallery which ought to be republished in full. I append one or two specimens. In Fig. 5 there is shown the Vesalian view of the base of the brain, with the origin of the cerebral nerves. It will be seen from this that Vesalius divided the nerves into eleven pairs—the olfactory, the optic, the motores oculorum, the trochlear, the trifacial, the abducens, the portio dura, the portio mollis, the glosso-pharyngeal, the pneumogastric, and the spinal accessory.

According to our modern reading of parts, the most defective exposition in this drawing is in the origin of the nerves from the medulla. The columns of the medulla are also wanting in definition.

In another drawing we have brought before us the profile or side view of the brain. In this work the proportions are admirably preserved, and the distributions of the nerve trunks are faithfully followed. The divisions of the trifacial are executed with the

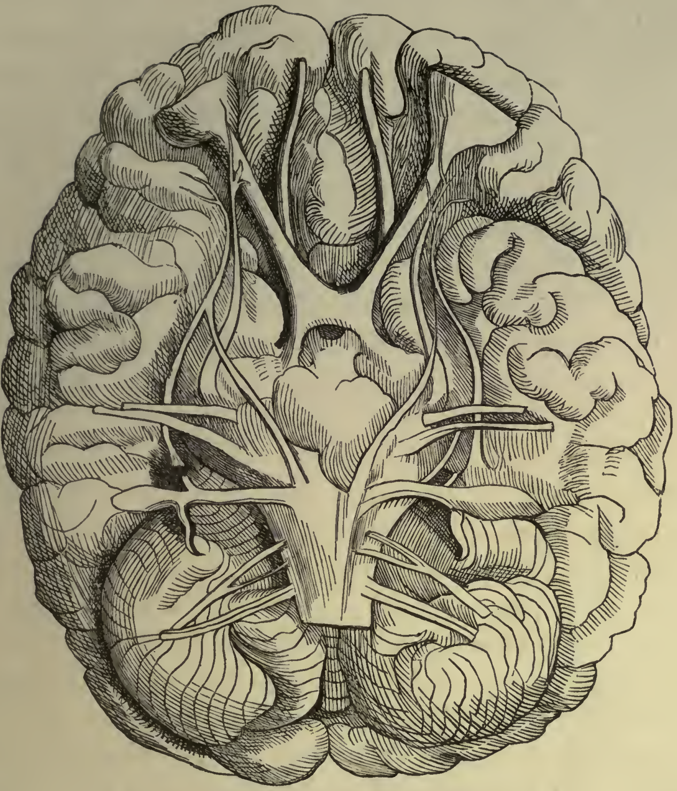

FIG. 5

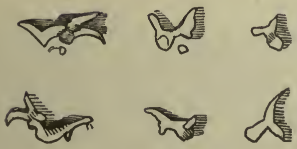

FIG. 6.

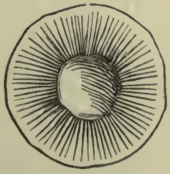

FIG. 7.

utmost care, and the large descending par vagum is boldly outlined.

Connected with the nervous system, the organs of the senses are not forgotten, but they are, it must be confessed, less perfectly depicted. The eye is the only organ of sense freely illustrated, and that not, in all cases, correctly. The crystalline lens is placed too far back, and the drawing of other parts is hard. The iris copied in Fig. 6 (p. 145) is an exception; it is better drawn. The construction of the organ of hearing is not illustrated connectedly, but the three bones of the middle ear, the malleus, incus, and stapes, as will be seen in Fig. 7 (p. 145), are fairly pourtrayed.

The structures which form the vocal organs are rendered with considerable care, and one view of the larynx and windpipe (Fig. 8), showing the branching off from the pneumogastric and the return of the left recurrent laryngeal nerve, is a fine study. In Figs. 9 and 10 two views of the larynx are copied.

To the parts and organs concerned in the process of digestion Vesalius paid the closest attention, and his large views of the whole of the alimentary system are worthy of an anatomist of to-day. In Fig. 11 there is presented his view of the stomach, in which he depicts the three coats—the external coat of peritoneum (AA); the two layers of muscular or fleshy fibres (BB); and the inner or lining coat (C).

In other drawings he delineates the stomach turned inside out; the different parts of the intestinal canal; the opening of the bile duct and pancreatic duct into the duodenum; the mesentery; and the spleen.

The organs of generation, the kidneys, the bladder, the liver, are also illustrated, the kidneys less effectively than the other parts. The lacteal system and the absorb-

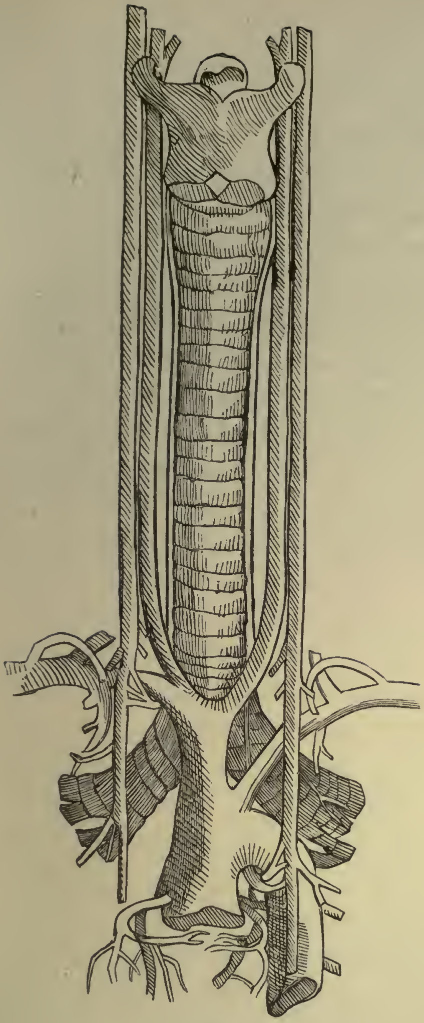

FIG. 8.

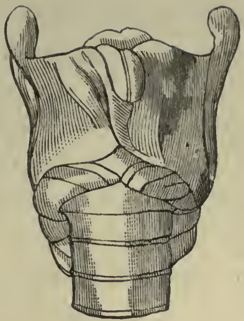

FIG. 9.

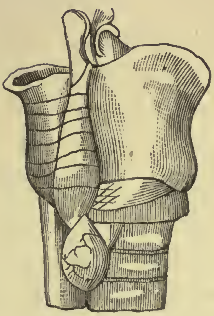

FIG. 10.

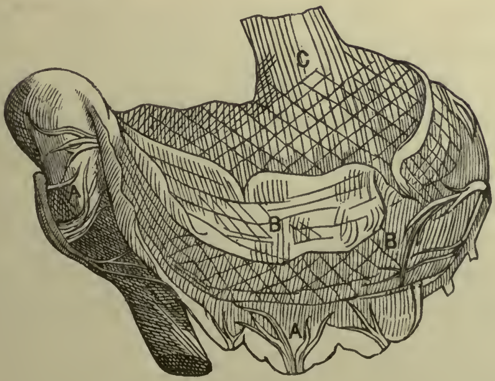

FIG. 11.

ent system generally, is lacking; for although Galen was conversant with some of the lymphatics, thinking them to be parts of the circulation; although Fallopius had seen lymphatic vessels in the liver; and although Eustachius had discovered the thoracic duct, Aselli, Jolliffe, Bartholin, and Rudbeck had to appear before the anatomy of the lacteal and lymphatic vessels was added to the common store of scientific learning.

I have spoken thus far of the dissections and plates of this famous book, and there is little need to say much more. The dissections and plates are the book. The text is plain, concise, and common sense, but is not peculiarly attractive nor great. It describes what has to be described well, but it is not inspired with new thought. The strangest indeed of all facts in the text is the one fact that its author could have disclosed so much and not discovered more. The whole mechanism of the circulation, for example, is laid bare by his hand, and yet he knew nothing of the circulation. Heart, arteries, veins, valves,—he dissected them all, but to him they were dead. He saw the heart, but not the circulation. It required the genius of Harvey to see and describe the "De Motu Cordis et Sanguinis," and yet, perchance, Harvey had never seen the motion had Vesalius not traversed the circuit.

The fame of the great book soon spread far and wide. It was republished in Germany, in Holland, in England, translated from the original. In England three editions of an epitome of it followed each other from one man, Thomas Geminus, or Gemini. The first edition of Geminus was published in Latin, in 1545, in London, under the title "Compendiosa Totius Anatomiæ Delineatio, ære exarata." It is dedicated to Henry VIII., and contains the Vesalian plates well executed. The work is believed to be the earliest anatomical treatise published in England, and the first in which the roller printing process was employed.

In 1553 Geminus published the second edition, in which the letterpress is translated into English. This copy is dedicated to the then King, Edward VI., with a commendatory note as follows :—

"To the gentill readers and Surgeons of Englande, Nicolas Udall in the Lorde gretyng with encreace of good knowelage."

The volume was "imprynted at London by Nycholas Hyll, dwellynge in Saynte John's Streate, for Thomas Geminus."

In 1559 Geminus published a third edition (in English), dedicated this time to the most high and virtuous Princess, Queen Elizabeth. This copy is believed to contain the first published likeness of the Queen, and, sooth to say, it does not flatter her. She is presented in the centre of an illustrated title-page, and, by the strangest of coincidences, above the Queen, enthroned in a kind of temple, sits another Queenly figure, with a pen in her right hand, a wreath on her left, and her foot upon the great globe, and styled "Victoria."

Oh, Gemini ! hadst thou prophetic virtues ?

This third edition was imprinted at London, within the blackefryars, by Thomas Geminus himself, "Anno Salutis 1559, Mense Septemb." A royal copy of this edition is in the British Museum, with the Vesalian plates complete, although some ignoramus has touched them over with a coat of red colour, to the serious detriment of the delineations of the brain.

In these two last editions Thomas Geminus seems to me to have rather imposed on his readers by making the volumes too much like his own productions, and too little like those of Vesalius.

Later in history, 1725, Boerhaave and Albinus republished in Latin the "Opera Omnia" of Andrew Vesalius, with the anatomical drawings illustrated in perfection of style, and with a noble preface, containing the life of the anatomist. Of all the editions of Vesalian labour since Vesalius, I like this by far the best, and recommend the classical Esculapian never to miss the opportunity of adding it to his library.

"EPITOME DE HUMANI CORPORIS FABRICA."

In the same year as that in which the great book was issued, there was published by Vesalius an epitome of it, dedicated to the Prince Philip, and illustrated. This also was published at Basle "Mense Junio, 1543," printed on vellum, with the same frontispiece as that which accompanied the plates, and with the addition of a likeness of Vesalius by John Stephan de Calcar. The likeness is reproduced, by the autotype process, in the frontispiece of the present ASCLEPIAD, from that in the vellum edition of the original work of 1543 in the British Museum. It presents Vesalius in his twenty-eighth year, probably in professorial costume, and engaged in dissection of the muscles of the fore-arm. The vellum edition of the epitome in the British Museum is a rare book, and is in splendid preservation. It is believed to be the copy sold at the sale of Dr. Richard Mead for £8 12s. 6d. There is a similar copy in the University of Louvain. The likeness of Vesalius has never before been reproduced by autotype, and I think I may say never before so faithfully, as in the plate now presented to the readers of this essay. It does not flatter, but is more characteristic of the anatomist than the better-known copies of the portrait in oil, by the same artist, in the possession of the Royal College of Physicians, or of that in the Hunterian Museum, at Glasgow, which has been ascribed to Titian.

Three or four minor works of Vesalius have been added to the great work, and after his death, a pupil of his, Prosper Borgarucci, published a digest of a Vesalian treatise on surgery, entitled "Chirurgia Magna in Septem Libros Digesta." I need not dwell on these productions, which, as mere offshoots of a great mind, do not add to the glory of its mission. Better is it to follow to the end the career of the master, and depict his departure *ex hac turbâ et colluvione.*

One word, however, before leaving the works, bearing upon the conscientious care of the worker. The "De Humani," as well as the "Epitome," was printed, as we have seen, by the learned John Oporinus of Basle. To Oporinus, Vesalius wrote a letter, dated September 9th, 1542, in which his scrupulous care for correctness is well displayed. He advises Oporinus, that the woodcuts of the work have left Venice for Basle. He begs him to take the greatest care that the printing of the illustrations shall correspond, in the fullest degree, with the artist's proofs which accompany the blocks. "Every detail must be distinctly visible, so that each cut may have the effect of a picture." He complains of the rough plagiarisms of his plates, and explains that the woodcuts now sent were done at his own expense to ensure accuracy.

The Court Physician.

Charles V. of Spain—father of that Philip who came to England, and married our most unhappy of

English queens, Mary—called the anatomist to his court, as Archiatrus, in 1554. In the following year. Charles abdicating in favour of Philip, the office was continued to him by the new emperor, who, wicked, false, and treacherous as he was by nature, played fast and fair with the Archiatrus.

In 1559 Vesalius was sent, by Philip, to France to attend Henry II., who, in the midst of the marriage revels connected with the espousal of his daughter Elizabeth with Philip and his sister Margaret with the Duke of Savoy, had run a tilt in a tournament with the Count Montgomery, and received the shaft of the Count's broken lance in his right eye. Vesalius accepted the mission, but was too late to render service. On his arrival at the French court the king was dead.

In 1560 Vesalius followed Philip to Spain, and Don Carlos, son of the Emperor, having received an injury on the head, was treated by him, and, as the word went, was "cured." The credit of the "cure" capped the fame of the anatomist, and the curer became fashionable as well as famous. Another event, which Thuanus, a trustworthy historian, records with much admiration, added to the notoriety. Maximilian d'Egmont, Count of Buren, a general and a favourite of the Emperor, lay ill. Vesalius, as physician in attendance, pronounced the illness fatal, and predicted that life would not continue beyond a certain day and hour. The Count, accepting the prediction as true, invited all his friends to a grand feast immediately preceding the fatal moment. After the banquet he made presents to his guests, bade them an everlasting farewell, and, like a true and obedient patient, expired at the very moment Vesalius had named as the time for the prescribed exit. Vesalius probably was not the first, and he certainly was not the last, physician who has gained credit by such *sors prospera*.

"Let him that thinketh he standeth take heed lest he fall." The Archiatrus, at one moment in the zenith of his living eminence, was stricken the next, as by a mortal blow, to see the cloudless vision of life no more.

THE PILGRIM.

In the early spring of the year 1562, Vesalius left the court at Madrid in a mysterious way, or, more correctly said, for a mysterious reason, which has never been clearly explained. He was famous, a court favourite, and so rich that it is asserted he lent considerable sums of money to several young and noble Spanish spendthrifts at a high rate of interest, on the condition that they would repay him when he should return. He travelled to Venice by Perpignan, but was delayed by litigation at the Spanish customs house, owing to his determination to save a small bribe, which cost him in the end a fortnight's detention and fifty crowns.

From Venice he started to Cyprus in company with General Jacobo Malatesta, the commander of the Venetian forces in that island. From Cyprus he then passed to Jerusalem on pilgrimage to the Holy Land, like one, it is assumed, who had lost caste, for a time at least, if not for good, and who was expiating some great offence. What is the mystery?

Five speculations have been advanced in explanation. Swertius, thought an authority, lays it all on Signora Vesalius, a querulous and imperious woman, who made home so unsupportable that her husband resolved to escape on the pretext of fervour for pilgrimage.

Joannes Imperialis, another authority, assigns as the motive the desire to be free from the anger of the members of the Galenic school, and the fear that they would undermine him with the Emperor and cause him to be dismissed from court.

A third explanation is that, as the Archiatrus tasted riches, he grew more and more in love of them, and that to add to his wealth, he visited Palestine.

A fourth idea is that during a long illness he vowed to do a pilgrimage should he recover.

The last hypothesis, the most probable and the most accredited, is supplied by Hubertus Languetus—Hubert Languer—a tragic exposition thus expounded:—"Vesalius, believing a young Spanish nobleman whom he attended to be dead, obtained leave of the parents to open the body for the sake of inquiring into the cause of the illness, which he had not rightly comprehended. This was granted; but he had no sooner made an incision into the body than he perceived the symptoms of life, and opening the breast, saw the heart beat. The parents coming afterwards to the knowledge of this, were not satisfied with prosecuting him for murder, but accused him to the Inquisition of impiety, in hopes that he would be punished with greater rigour by the judges of that tribunal than by those of the common law. But the King of Spain interposed, and saved him on condition that by way of atoning for the error he should undertake a pilgrimage to the Holy Land."

Jacobus Magnetus gives credence to this explanation. Boerhaave and Albinus think it possibly true. If it be true, Vesalius failed to diagnose catalepsy from death, a pardonable error in his day, perhaps pardonable even now in extreme examples of that disease.

On the 9th October, 1562, the pupil of Vesalius, the brilliant Fallopius, only forty-one years of age, died at Padua, leaving vacant the first chair of physic in that wonderful school of medicine. A worthy successor it was hard to find, and at length, in 1563, the electors, the Senate of Venice, sent after the wandering Andrew Vesalius, still on the pilgrimage business, to return to Padua and assume the vacant chair. He received the message at Jerusalem, and in the autumn of the following year set sail, probably from Joppa, for Italy. The voyage was unfortunate. A violent storm drove the vessel upon the Ionian Islands, and wrecked it on, or near, the island of Zante, on which island, stricken with cold and hunger, the great anatomist—Archiatrus probably no longer—yielded up his breath, upon the 15th October, 1564, six months, less eight days, after the birth of our Shakespeare, and fourteen years before the birth of our Harvey.

A friendly goldsmith of Venice, recognizing the body of Vesalius, gave it modest burial in the Church of Our Lady in Zante, and inscribed over the tomb:

ANDREÆ VESALII BRUXELLENSIS TUMULUS,
QUI OBIIT IDIBUS OCTOBRIS,
ANNO MDLXIV.
ÆTATIS VERO SUÆ QUINQUAGESIMO
QUUM HIEROSOLYMIS REDIISSET.

This is the history generally accepted of the last days of the Father of Anatomy. There is another story, that he died from sheer avarice; that he refused to provide himself with sufficient food for his voyage, was too proud to beg, and although relieved by a friendly German fellow passenger, underwent such starvation that on reaching Zante he succumbed from long fasting and cold. Had this story, or other such stories against him, been true, the Church would not, I think, have been his friend, for it never loved the scientific scholar. Yet after his death the Capuchins, occupying a house in the High Street of Brussels, on the site of which house Vesalius had lived, dated their letters, "*Ex ædibus Vesilianis.*"

In Andrew Vesalius, industry, courage, and skill in exposition were the living attributes which gave him power in his own time, and enduring power after his own time. His mind, the purest analytical, was fitted strangely to unravel and expose natural secrets, but was poor in constructive or synthetic quality, and, therefore, weak in discovery of the natural principles or designs relating to the parts of natural objects; the mind of an anatomist as distinguished from a physiologist, the logos left out altogether. Intense, proud, and perhaps avaricious both of fame and wealth, he was borne on, nevertheless, by a magnificent impulse towards, and to, as magnificent a fame as ever befel a soul of science of any age or race.

THE PRESCRIPTION FOR ALCOHOL IN DISEASE.

BY one of those clear and unmistakable revolutions of thought which come out of much contention and laborious research, it is now all but universally admitted by men of science that to those who are in the enjoyment of good health, stimulating drinks are of no service whatever; that such drinks do not help to maintain health, and that the most which can be said in favour of them is that they supply what is called a luxury. There remains, however, as yet, an argument which is to the effect that alcohol is an agent admitting of being applied with very good effect for the service of persons who in various ways are out of health. My object now is to consider with all candour that position. It were a singular anomaly in nature if what is not necessary as a general principle or rule of life for maintaining the healthy in health were necessary for bringing the unhealthy back to health, and for keeping them in health. But as such is assumed to be the case by many whose opinions are worthy of the highest consideration, those who abstain should be ready to consider the position asserted by those who do not abstain.

DEATHS FROM NEGLECT OF ALCOHOL.

The first of the arguments that has been set forth by the medical advocates of the use of wine and other alcoholic drinks is that there are conditions of disease in which, according to the experience and belief of the advocate, such drinks are essential. Some of these advocates have seen sick persons sink and die, such persons, in states of great enfeeblement, having doggedly, and with a devotion worthy of a better cause, refused stimulants and collapsed. On this class of persons many physicians are most severe in their criticisms; but it is not a little remarkable that, being so severe, they forget that numbers of enfeebled persons collapse and die who were not in any way dogged against the use of stimulants, but, on the contrary, were ready and willing at any moment to take stimulants.

This, I think, shows an error on the part of medical advocates of alcohol, and indicates how easily the human mind, when it has been long educated in one direction, forces one-sided propositions first on itself and then on the world at large. There are thousands of medical men who have seen a far greater number of people who to their last were wine-drinkers, or spirit-drinkers, or beer-drinkers, die from exhaustion than they ever did of people who to their last were total abstainers from such assumed life-preserving liquids. I notice that in one period of ten years there died in England and Wales 4,794 persons whose deaths appear in the mortality as from exhaustion. Out of these it would be difficult to find fifty who raised a dogged objection to alcohol. The grand majority died from exhaustion, under the benefit of alcohol, if they availed themselves of it, and availing themselves of it in a large number of the cases, the majority still died from exhaustion. Here is an experience as valuable as it is memorable. Suppose I argued from it that in my opinion many of those exhausted persons would have been saved if alcohol had not been supplied to them. That, I confess, might be called a fanatical supposition. How equally fanatical, however, is it for anyone to argue from a single, or even from a score of deaths from exhaustion without alcohol, which he may have known of, that therefore those deaths were due to the withholding of alcohol.

The question is a numerical one, and will be considered as such in the long run. It will have to be argued out from general mortalities, not from individual experiences. If the great facts of mortalities should show that in abstaining communities the rate of mortality is less than in communities that indulge in a moderate use of alcohol, to say nothing of an excessive use, then, were individual experience exceptionally correct, it would be very bad for the individual experience so to announce itself as to allow it to draw a general inference out of a particular, and so make the general good subservient to the individual. On this argument I might present a powerful advocacy, at the present moment, in favour of total abstinence in disease, for the evidence on every side from which it can be extracted is to the effect that the abstaining classes, in alcohol-drinking communities, live the longest lives and suffer least from disease. I prefer, however, appealing chiefly to the temperance community on the medical aspect of the alcohol question to ask:—What common basis is there on which the professors of healing and the abstaining public may stand in harmony?

On one hand, I am quite sure that the professors of medicine have as full right to use alcohol as they have to use any other medicinal agent. No clamour from the public ought to interfere with them in this part of their work. For myself I claim the perfect right, and I exercise it according to my best judgment with entire independence. I have prescribed alcohol for abstainers of the purest type, as I have chloroform, ether, and other medicinal substances. Against such legitimate use abstainers should not object, unless they can show by their learning that their objection is founded on sound physiological data bearing directly upon the facts of the case in which their objection is raised.

On the other side, in common fairness to scientific progress, the professors of healing ought so to prescribe alcohol that nothing shall be wanting in accuracy of prescription. The exact quantity, the exact quality, the exact purity of the alcohol ought to be known, and due provision made to ensure what is right in respect to quantity, quality, and purity. To prescribe wine without knowing whether the specimen of wine contains ten, fifteen, or twenty per cent. of alcohol; to prescribe spirits without knowing the percentage of alcohol, or whether all the alcohol in the spirit is ethylic alcohol or a mixture of alcohols; to prescribe either wines, spirits, or ales without asking whether other chemical bodies than alcohol are or are not present in them, is not prescribing at all. Any old woman, or any quack, can prescribe in that mad-cap way. It is the duty of the physician to order, in fact, the absolute remedy, to define the dose, and to direct the time of administration with the same care as if he were prescribing opium, chloral, or other active remedy. In prescribing he has before him a precise therapeutical intention, and he must be precise in prescribing if he would ensure the fulfilment of his intention.

If this view of the position spoken of were fairly taken, all difficulties between the prescriber and the public would soon cease. I have myself followed this plan for ten years past, with the utmost facility of action. When I want to administer alcohol I write it in the prescription as absolute alcohol—Sp. Gr. 0·795—and I have it mixed with water to make it easy and ready for administration. In but three instances amongst all the total abstainers whom I have attended have I met with a demur.

This plan has also led me to form a far more accurate estimate of the real value of alcohol than I had ever before been able to obtain. When we say to a person, "Take so much wine or spirit," it is not only that we do not know the amount of alcohol contained in what is ordered, but that we are never quite sure about the quantity that will be given or taken. There is a carelessness in the process because when wine is spoken of, a little more or less of it is too often thought to be of no moment. But with alcohol in measured doses there is a definite method, and all the results stand out clear.

OPUSCULA PRACTICA:

USEFUL NOTES FOR BUSY PRACTITIONERS.

"There are mites in science as well as in charity."
BENJAMIN RUSH.

OXALIC ETHER.

AN ADDITION TO SURGICAL ART.

I PRESENT this quarter a new remedial agent which will, I believe, play as useful a part in surgery as the ethylates and colloids, which I have introduced into that division of our art, have already played.

Oxalic ether may be obtained by the mere process of digesting equal parts of oxalic acid and absolute alcohol for ten hours at 120° F., with a tube from the flask to carry over the ether into a condenser. It may also be obtained by heating one part of dehydrated oxalic acid with six parts of absolute alcohol with distillation and purification. Several details have to be attended to, which render the process tedious; but with care the ether is obtainable in free quantities and pure. For my research I was indebted to Mr. Williams, of the firm of

Hopkin and Williams, for the preparation of a pure specimen.

The ether, at ordinary temperatures, is a colourless liquid of a pleasant odour, but a decidedly biting taste. Its composition is $C_6H_{10}O_4$. It boils at 183° C., 361° F. Its vapour density is 73° by hydrogen as unity. Its specific gravity is 1·090. It is soluble water to the extent of four per cent. by volume. In alcohol and ethylic ether it dissolves readily.

The behaviour of oxalic ether with water and with alkalies is peculiar. Water converts it, after a time, into alcohol and oxalic acid. The alkaline solutions of potassa and soda convert it into alcohol and oxalates of the bases. Ammonia solution converts it into alcohol and oxamide,—$C_2\ N_2H_4O_2$.

From the nature of these changes I thought it would be worthy of observing if oxalic ether would undergo chemical changes within the organism. It is too heavy to admit of being readily administered by inhalation, but it is easily introduced hypodermically; and I suspected that, introduced in this way, it would be decomposed in the alkaline blood as it is out of the body, and that, in addition to the local action, there would be set up a narcotic action from the absorption of liberated alcohol, with some new train of systemic changes from the absorption of alkaline oxalate.

Instead, however, of finding any systemic change induced by the ether, I discovered that its action was expended purely in local effect. Too insoluble in water and blood to be absorbed into the body rapidly, it is decomposed at the point where it is introduced, and acts there, perhaps, exclusively. Its action is to coagulate the albuminoid structures, and to produce almost painlessly a free and dry eschar, without any marked constitutional disturbance, unless the quantity injected be excessive.

In the strict sense of the word oxalic ether is a local destroyer of tissue, but is not a caustic; it takes up the water of the tissues, and in its decomposition destroys the vital structures, the new products into which it is resolved, alcohol and oxalates, combining with them. The destroyed surface is left desiccated as well as dead.

Oxalic ether promises to be of service in application either by the brush or by needle injection for the removal of morbid vascular growths. In the treatment of malignant growths I expect it may perform a more important part than any other agent that has yet been introduced as a local remedy.

USEFUL COMPOUND COLLOIDS.

PRACTITIONERS not unfrequently write to me to ask what are good additions to, and combinations with, styptic colloid. In answer some revised formulæ for a number of compounds with it, originally published in the first announcement of the colloid in the *Medical Times and Gazette* for April 6th, 1867, are herewith supplied.

Creasote Colloid.—With the creasote of the shops the styptic colloid forms an excellent compound. The creasote acts well as an additional antiseptic, and also as a solidifier of albumen. It produces, however, some degree of irritation. The proportion is ten minims of creasote to one fluid ounce of the colloid.

Carbolic Colloid.—With pure carbolic acid the fluid also combines. The compound so produced possesses, practically, the same properties as the mixture with creasote. The combination is powerful, but produces little irritation. Proportion, ten grains of carbolic acid to one fluid ounce of the styptic.

Quinia Colloid.—The pure alkaloid quinia dissolves in the styptic fluid, and forms a good solution. The quinia adds to the antiseptic power, but, I think, takes away somewhat from the adhesive property of the colloid. Proportion, five grains of quinia to the fluid ounce of the styptic.

Iodized Colloid.—Iodine unites readily with styptic colloid. The combination is most useful in cases where there is purulent or fœtid discharge from a surface surrounded with indurated tissue. The iodine produces no irritation. Proportion, ten grains of iodine to an ounce of the styptic.

Iodide of Cadmium Colloid.—Iodide of potassium and iodide of ammonium do not readily combine with the styptic; but iodide of cadmium, which possesses similar physiological action, goes up in it readily. Proportion, half a drachm of the cadmium salt to an ounce of the styptic.

Bichloride of Mercury Colloid.—The bichloride of mercury is soluble, in small proportions, in the solution, and the compound is a most useful application in indolent syphilitic ulcers, and sometimes in lupus. Proportion, half a grain of the bichloride to one ounce of the styptic.

Morphia Colloid. — Morphia goes up well in the solution, and in irritable painful ulcer a compound of morphia and the styptic is of service. Pain is often relieved, and healing promoted. This compound, on cotton, is good as a stopping for a hollow tooth, to relieve toothache. Proportion, four grains of the alkaloid to an ounce of the fluid.

Atropia, aconitina, and all the other narcotic alkaloids, in their pure form, go up in the solution.

Cantharidine Colloid.—Cantharidine, on the addition of a little chloroform, can be taken up in the solution. The compound produces what may almost be called a dry blister, the fluid secreted being taken up, as it is exuded, by the styptic. There are cases in which this blistering fluid is a very considerable advantage; indeed, it would probably be an advantage in all cases in which a blister is required. Proportion, two to four grains of cantharidine to the ounce of colloid.

Chloride of Zinc.—Chloride of zinc, which, in solution, has been used for the dressing even of fresh wounds, makes a good compound with the styptic. Proportion, ten grains of the chloride in an ounce of the colloid.

Of these compound colloids the iodine and the zinc forms have found most favour. For the local application of iodine to the skin, and for the application of iodine to fœtid wounds, the iodized colloid answers usually with good effect. The carbolic colloid is also very useful, and is often applied by the dentists for relieving the toothache arising from a decayed, cavernous tooth.

◆

ACOUMETRIC DIAGNOSIS WITH HUGHES' ELECTRIC BALANCE.

IT is announced in some of the scientific papers that Professor Graham Bell has recently invented an instrument for measuring sound, which instrument is intended for the detection of deafness. If it is assumed—and I fear it is—that this is a new discovery and a new practical application, the assumption cannot, in justice, be too quickly dispelled. Professor Hughes' electric balance, which, under the name of the "Audiometer," I exhibited for medical use, in May 1879, at the Royal Society, is not only the original invention, but is so good and practical that it really leaves nothing to be desired, when the working of it is understood. The capacities of each ear for detecting sound can be determined by it with the utmost nicety, and for months together the instrument keeps in order, even though it be used every day.

After employing the balance frequently many little points of diagnosis occur which, at first puzzling, prove useful when they are unravelled. To take one case in illustration. I have observed that, when deafness is produced by the lodgment of some solid bodies in the ear, the audiometer does not detect the failure so well as when the drum of the ear is itself thickened, or when the cause of the deafness lies, beyond the drum, in the middle or the internal ear. This proves, that some bodies impacted in the ear and causing deafness convey the sharp telephonic vibration from the microphone so well, that, from the examination with the instrument, the deafness is not indicated, a fact which I turned to account with benefit in the case of a youth who had been very deaf in the left ear for many years, but who could hear through the audiometer almost down to zero. On carefully examining the ear, under the impression of the presence of some foreign body, I detected close upon the drum a very hard substance, which gave a resonant sound when touched by a metal rod. I got Messrs. Krohne and Sesemann to make for me a delicate wire hook, fixed in a strong handle, with which I managed to obtain a purchase behind the hard substance, and so to loosen it from its hold. I then syringed the ear freely, and soon washed out a small hard stone, a minute pebble, which explained all. The patient remembered that, when a child, playing on the sea shore, he had put the pebble in his ear, and had suffered afterwards from ear-ache, but had no suspicion that the pebble had remained. His deafness was immediately removed, and he has been quite free of any defect ever since.

FURTHER NOTES ON RHIGOLENE OR AMYL HYDRIDE.

IN the last Asclepiad I introduced, in this department, a short note on amyl hydride, called in commerce rhigolene, with reference to its use as a local anæsthetic. It may not be out of place here to add one or two more facts relating to the use of the hydride, in practice.

For Burns.—Camphor and spermaceti dissolve in rhigolene freely. The solution so formed may be applied with cotton-wool to burns. The evaporation of the fluid gives instant relief to pain, and leaves over the surface a thin layer of spermaceti and camphor, which excludes air and forms an excellent dressing. One drachm of spermaceti and one drachm of camphor will dissolve in two fluid ounces of rhigolene.

For Iodine Disinfection.—The hydride takes up iodine, making an iodine solution, useful for various purposes. Applied to the surface of a fœtid wound, it leaves the iodine on the surface in finest subdivision. Sprayed into the throat, the solution is useful in malignant or fœtid ulceration, one or two injections of the spray being quite sufficient to leave free iodine upon the surface. Inhaled as a weak solution, it affords a means of allowing iodine to enter the respiratory tract, a little iodine being always carried over with the vapour. The strength of the iodine solution which I use is five grains of iodine in one fluid ounce of rhigolene. One of Gamgee's excellent absorbent pads treated with half a fluid ounce of this solution becomes an iodine sponge, applicable for a variety of purposes.

For Antiseptic Use.—By shaking a strong solution of ammonia with the rhigolene and then decanting off the water, an ammoniated solution is obtained, which acts as an antiseptic for inhalation. The same solution charged with camphor is useful for the preservation, temporarily, of natural history specimens, by putting them into a bath of the solution, letting the fluid escape as vapour, and leaving the camphor in the tissues.

ANODYNE COUNTER-IRRITATION.

WHEN what I called voltaic narcotism was on hand, I noticed that if by a strong counter-irritation the surface of the body, in any part, were rendered very vascular, the absorption of a narcotic applied to that surface caused a local insensibility much more intense than if the narcotic had been simply placed on the skin in its natural state. Upon this indeed rested the curious series of phenomena of local anæsthesia by which a considerable number of surgical operations were painlessly performed. The fact has led me often, since then, to combine a narcotic with a counter-irritant, as follows :—

1. Mustard, four tablespoonfuls; tincture of opium, two fluid drachms; glycerine, one tablespoonful; water,

heated to 100° F., sufficient to make a thick paste. To be applied on sponge or on linen in the usual way.

2. Mustard, four tablespoonfuls; soda carbonate, half an ounce; Dover's powder, one drachm; glycerine, one tablespoonful; water, heated, sufficient to make a poultice. This forms an alkaline as well as anodyne counter-irritant, for lumbago and muscular pains.

3. Cantharidine plaster, one drachm; extract of belladonna, one grain. To make an anodyne blister. This is useful for the blister at the back of the ear, in cases of pain from sub-acute inflammation.

4. The substance in the pharmacopœia called Emplastrum Calefaciens is a good medium for anodyne counter-irritation. With it morphia, codeia, and other alkaloids combine well, on addition of a little glycerine.

A MUSTARD SPONGE.

I REFERRED above to sponge as a carrier of the poultice. Let me explain this as another little practical hint. A sponge makes the best of mustard carriers. The nurse mixes the mustard in a basin with water until the mass is smooth and of even consistency. Then she takes the soft mass all up with a clean sponge, lays the sponge in the centre of a soft white handkerchief, ties up the corners of the handkerchief neatly, to form a hold, and applies the smooth convex surface to the skin. This mustard sponge, warmed again by the fire and slightly moistened, can be applied three or four times, is good for several hours, and saves the trouble of making a new poultice for reapplication, often a matter of importance during the weariness of night-watching. The sponge can afterwards easily be washed clean in warm water.

RESEARCHES ON RESUSCITATION, FROM SOME STATES OF SUSPENDED LIFE, BY THE PROCESS OF ARTIFICIAL CIRCULATION.

THE fact that so able and well-known a man of science and public teacher as Dr. Andrew Wilson should have republished, in *Health*, and commented on some experiments on re-animation which have been reported from America leads me back to certain of my own original researches on this great subject of inquiry.

I notice, in passing, that the experiments to which Dr. Wilson directs attention are, in effect, experiments of transfusion of blood, and recall not only some of the earlier researches with that process after Sir Christopher Wren suggested it, but other researches in the development of the process by the late Dr. Blundell, Dr. Kaye, Sir Charles Hastings, and many more observers, who witnessed instances in which revival from what seemed to be absolute death from loss of blood was brought about by the direct transfusion of blood from another animal of the same species. To some extent, therefore, Dr. Wilson's very proper scepticism respecting the new experimental results may be qualified. But that which is peculiar regarding these new experiments, and on which it is fair to be sceptical, is the suggestion that the animals, which had been brought into a condition resembling that of death, were not only dead, but had actually passed into the state of *rigor mortis*, and that recovery still occurred, even after a lapse of several hours.

Without waiting for any corroboration of the statements here referred to, I will once again, and quite independently, report on a part of my own work on the subject of resuscitation, not only that the work may be kept in remembrance, but that it may be a guide to other investigators in the future.

I should premise that my inquiries were all originally instituted with the view of restoring life after fatal collapse from syncope, and from the effects of such narcotic agents as chloroform, administered for the production of insensibility during surgical operations. Afterwards death by drowning came also under inquiry, and death by drowning and cold. The earliest of these researches, made in 1852-3, and published in the *Association Medical Journal* in 1853, had relation to death by syncope. In them I tried the effect of restoring the circulation by the inversion of the body of an animal so as to bring a current of blood to pass by its mechanical weight from the right heart into the lungs. The research then moved into another stage, in which various methods were employed, by artificial respiration, to re-induce a pulmonic circuit of blood. Later on a number of methods were instituted in order to attempt to supplement the circulation itself, for which method I invented the term *artificial circulation* (*Proceedings of the Royal Society*, July 15th, 1865).

In this last-named series of researches I endeavoured to carry out artificial circulation with the addition of artificial respiration, electrical excitation, and application of heat to the apparently lifeless bodies. In the present paper I propose to condense the leading facts of this investigation.

In order to establish artificial circulation in the lifeless animals various processes were adopted, which I will briefly re-state from the original essay, communicated to the Royal Society.

I should premise by saying that in the majority of cases the dead animal was a rabbit; that in every instance the death was lethal, and, therefore, painless; and that the attempt to resuscitate was never made until every recognisable sign of life had ceased.

Artificial Circulation by Injection of Oxygen over the Venous Circuit.

I thought that by puncturing a vein, introducing an injecting tube, and forcing gently a current of pure oxygen, warmed to the natural temperature of the body under observation, that I might, as it were, supplement the lungs in their function, and by the gaseous pressure drive over a column of oxygenated blood into the left side of the heart, by which the structure of the heart would be fed through the coronary arteries, and all the extreme parts of the body through the arterial distribution. But this process, though it was many times repeated, produced no more than a temporary effect upon the heart. Under the influence of the oxygen the right auricle and right ventricle never failed to be moved into brisk rhythmical contraction, which could sometimes be prolonged for an hour by simply repeating the introduction of the gas at intervals; but the contraction of the ventricle was at no time sufficient to cause a current of blood to pass through the pulmonary circuit.

Artificial Circulation by Injecting the Arterial System with Oxygen.

Injection of the arterial system with oxygen led to some singular half-way results. In this process an artery was laid open after all signs of life were absent, an injecting tube was introduced, and the gas was gently forced towards the heart, so as to pass into the left ventricle, and by the coronary arteries into the heart itself. In one of these trials the heart, as the gas entered it, made a series of active movements, so powerful they could be felt through the chest-wall, as in life. But the motion soon ceased, although the injection was continued, and when the body was laid open the heart was found empty of blood and devoid of irritability. In another instance the injection of oxygen at 96°, twelve hours after death, into the structure of the heart, produced feeble contractions both in the auricles and ventricles, ending in *rigor mortis*, which had not previously been developed.

Artificial Circulation by Injection of Hydrogen Peroxide.

In the year 1818, Baron Thénard, the illustrious French chemist, discovered a mode of forming a remarkable chemical fluid, called peroxide of hydrogen. In this compound instead of water, H_2O, we have a fluid H_2O_2, which contains double the amount of oxygen existing in water, the additional oxygen being very loosely held, and becoming readily liberated by the presence of many inorganic substances, like platinum bichloride and binoxide of manganese, and by many organic matters, like blood-corpuscles, and fibrine of blood. For a long series of years the Hydrogen Peroxide was a chemical curiosity, but in 1858-9 I made an inquiry into its possible uses as a medicine and into its physiological properties (*Lancet*, 1860, vol. ii., p. 390), since which time it has been largely used in medicine.

From the facility with which oxygen can be injected in the fluid state into the blood-vessels, as peroxide of hydrogen, I anticipated great results from it in resuscitation. The solution used was charged with ten volumes of the gas, and was usually diluted with an artificial serum of saline chloride and albumen, rendered just alkaline by soda, and heated up to the natural blood temperature. In this solution the oxygen remains steady until it is injected, and the solution runs well from the syringe into the veins or arteries. On injecting this solution over the arterial system the blood in the veins became of a bright arterial colour, showing that liberated oxygen had passed into the capillary system, and, for a time, as the solution entered the extreme parts of the vascular circuit, vigorous muscular action was produced in the pectoral muscles, the muscles of the neck, and the diaphragm. There was, however, on no occasion any reaction of the heart.

The research with Hydrogen Peroxide was modified by introducing the fluid in small quantities by the trachea into the finer bronchial tubes and pulmonary air vesicles. I thought that by this means the remaining blood in the pulmonic circuit might take up the liberated oxygen, as the gills of the fish take up oxygen from water, and that a pulmonic current of oxygenated blood might find its way over to the left side of the heart, and so call the heart into contraction. The expectation was not altogether falsified, for some of the oxygen did make its way, in one case, into the left auricle and ventricle, where it combined with the blood there, and caused the auricle to contract vigorously. The effect, however, stopped there.

Artificial Circulation by Injection of Blood.

Injection of blood into the veins as venous blood, and into the arteries as oxygenated or arterial blood, was carried out with many varied details. Venous blood was injected by the vena cava superior through the right heart and over the lungs, while artificial respiration was kept up, and a current of blood was so truly made, that each portion injected could be drawn off from the vena cava inferior. To my great surprise the results were more decidedly negative than in previous cases, and were singularly poor compared with some after-results, which have yet to be recorded. In one instance, where every detail was perfect, where the lung circuit as well as the systemic was complete, and where the blood was well oxidized in the lung, there was no action in any muscle, and yet the muscles were fully capable of being called into action afterwards, as will be shown in the next paragraph. The blood returned by the veins unchanged as oxygenated blood; but it failed to light up the vital fire.

Artificial Circulation by Injection of Heated Water into the Arterial System.

In place of blood I injected into the arterial system of the dead animals simple water, raised to various degrees of temperature. In these researches I obtained some of the most remarkable of results. As the water found its way over the system, movements would sometimes occur in the muscles, voluntary and involuntary, and if the body were very cold, and the water at 120° Fahr., muscular movements were sure to be developed.

In the experiment referred to just above, when injection of blood failed to reproduce irritability, the injection of blood was replaced by that of water, at 125° Fahr. Immediately there followed return of muscular irritability generally, repeated, with each new injection, several times.

I reported to the Royal Society another example in which these movements were developed three hours after death, the body having been kept in a temperature of 40° Fahr. Again, I saw this same phenomenon after ten hours' exposure to a cold below 32°, the body of the animal having been opened, half an hour after death by chloroform, for the insertion of the injecting tube into the aorta through the left ventricle, and then left out during the whole of a night in the air, when there was hard frost. The water injected in this case was heated to 140° Fahr., and produced general muscular irritability, which lasted over fifteen minutes.

Artificial Circulation by Mechanical Propulsion of Venous Blood in its own Circuit.

It occurred to me to run a flexible tube from a syringe down the external jugular vein directly into the right ventricle of the heart, and, after tying the tube in the vein and compressing the vein above, to use the syringe as if it were an artificial right heart; to fill it, by the exhaust, from the blood of the heart itself; and then, by a gentle downward stroke, to force the blood over the lung and oxygenate it by artificial respiration. From a mechanical point of view the operation is not only most simple to perform, but correct in theory. In drawing up the piston the syringe fills as easily as possible from the blood in the auricle and ventricle, and there are the semilunar valves ready to fall so as to prevent any regurgitation from the pulmonary artery. On pushing the piston down there is no obstruction to the flow of blood into and over the pulmonic circuit, for the ventricular valves will rise, and the semilunar valves will open, with perfect ease to let the blood pass into the lung. Moreover, the blood, if it has not coagulated, does pass, and, under artificial respiration, can be arterialized in its transit. As I reported to the Royal Society in the essay of 1865, above quoted, the suggestion of this method occurring to me in bed, I was so struck by it that I got up in the middle of the night to carry it out. It failed then, however, and it has failed since, although I modified it by using an india rubber ball instead of a syringe for the propulsion,—a great improvement.

I expressed at first regarding this failure that the difficulties lay in the proper adjustment of the force employed, the vein or auricle giving way if too much force were used, and the pulmonary circuit not being made if the force were insufficient. There is also difficulty from the coagulation of blood and from capillary contraction. Yet, after a further study of the matter for twenty years, I still believe this original idea to be a true one for artificial circulation, and I have never lost faith in it for a moment. It introduces no fresh blood or other fluid; it opposes no mechanical principle; and it supplies a *vis a fronte* as well as a *vis a tergo*. It invents, in short, for the time, a supplemental right heart, which could even be constructed to give a pulsating stroke. Thus, so far as mechanism goes, it is all that is wanted. If any one asks me why then did it not answer, I reply that the blood sent round by the artificial circuit did not pass over the pulmonic circuit with sufficient force to enable it to be distributed through the arterial system of the heart and of the body at large, so as to relight the animal fire. The arteries are commonly left empty of blood, but are filled with gases or vapour, and the arterial tube is therefore like a syphon with a broken current. Seeing this, I devised the following experiment.

Artificial Circulation by Suction and Propulsion through an Artery.

I varied the above method by trying the effect of suction from the arterial side of the circulation. Into the abdominal aorta of the dead animal, I inserted close to the diaphragm the tube of a syringe, the barrel of which was connected with a little exhaust pump. After the tube of the syringe, which ascended into the thoracic aorta, was firmly tied in the vessel, I drew over the column of blood by the exhaust into the syringe, and, having filled the syringe with blood, drove the blood back, by the piston, upon the heart, and into the upper circulation of the body. In one of these essays the syringe filled instantly with blood richly arterialized from having been drawn over the lungs, and the blood sent back into the heart not only re-established the motion of the heart, both in the auricles and ventricles, but re-established muscular action for a brief period whenever it made its course.

The results of this method were better than when the artificial circulation was carried on through the right heart. But the operation is a rather complicated process, and hardly practicable for resuscitation, since it involves the opening of a large artery, within a closed cavity, where the vessel is saved from collapsing under the suction from the exhaust.

Injection of Blood by Pulsating Strokes.

I had observed in transfusion that the pulsating stroke from the artery of an animal supplying the blood greatly increased the value of the injection. In one instance the heart of a dead animal that had shown no motion for twenty-eight minutes resumed motion in both ventricles and both auricles, by the process of transfusing blood from the artery of another animal in pulsating current, although the supplying animal was anæsthetisized. This caused me to attach a value I had not previously estimated to the stroke of the heart. I expressed the idea I had of this value in my report to the Royal Society by the expression "that the stroke of the heart supplements, or, more correctly speaking, represents a certain measure and regulation of the force derived from the combustion of the blood," which force, I take it, is the prime mover; and that the addition of the pulsating stroke removes the necessity for the higher temperature which would be required if the circulation moved in an unbroken stream.

In order to test this point I constructed a machine which could be worked either by the hand or by an electro-magnetic motor, by which I could inject blood into the coronary system of a dead heart in perfect rhythmic stroke, at the same rate as the heart itself had been working during life, and, approximately, at the same pressure. With this instrument, assisted by my friends Dr. Sedgwick and the late Dr. T. Wood, I injected, in pulsation, defibrinated blood, heated to

90° Fahr., into the coronary vessels of a dog, with the result that, one hour and five minutes after the death of the animal by chloroform anæsthesia, its heart, perfectly still, cold, and passing into rigidity, relaxed, and exhibited for twenty minutes active muscular motion, auricular and ventricular. The action, which continued for a minute or two after the pulsating injection was stopped, was renewed several times by simply re-establishing the artificial pulsation and injection.

Artificial Circulation, in Pulsation, through the Arterial System at Large.

The experiment of injecting the body by its own blood through the veins led me to think of another process. I thought that if I inserted a tube into an artery, attached a little pump to the tube below the body of the dead animal, and then gently, by one forcing stroke, sent a small charge of some fluid into the arteries towards the heart, I should, through the arteries, force on a current into the veins, and so, by lifting up a column of venous blood, make the veins recharge the arterial channels. I expected then that, by drawing the piston of the pump back, I should see the distended and elastic arteries push a current by their own elasticity over all the body, and refill the veins and the syringe without any further addition of fluid from without; while another movement of the syringe back would, I believed, charge the arteries again. I should thus be placing outside the body an artificial pulsating left or arterial heart.

Any one who understands the mechanism of the circulation will see how correct, mechanically, this process is. It implies the use of only just sufficient fluid to charge the arterial syphon; it brings into play all the elastic structure of the arteries for the return-propelling current; it charges the heart by the coronary arteries; and it admits of propulsion by a regular pulsating stroke.

In one trial of this method, in which water at 115° Fahr. was used for the first charging by the abdominal aorta, there was a free return of blood into the syringe during the exhaust, a complete restoration of blood over the body, and such general return of muscular irritability and of reanimation, that I stopped the process in order to prevent a possible return to conscious life.

By using a double india rubber bellows, like those used for ether spray, and fitting it to a six-ounce bottle, worked on the same principle as my apparatus for transfusion, and by arming the bottle, by the exit tube, with a metal tube for insertion into an artery, I adapted the apparatus for immediate use on the human subject in any case of sudden death from chloroform or other anæsthetic; and, on one occasion, with the able assistance of my friend Mr. Gay and of the late Mr. Jordan, I brought the apparatus into use, after death, in the human subject. Too long a time, unfortunately, had elapsed to permit us to hope, in our present state of knowledge, for reanimation, but we opened the femoral artery, inserted the tube, and injected the arterial system with defibrinated blood, at natural blood heat, in pulsating stroke. There was no return of independent vital phenomena, but the current of blood from the arteries into the veins, and again through the arteries in steady circulation, was so perfectly sustained, that Mr. Jordan, feeling the pulse at the wrist, could not believe the pulsation was purely mechanical, derived from the outside artificial heart, until he counted the pulsations as they were delivered from my hand, and noted that they stopped when I ceased to produce them. The surface of the body, moreover, resumed its natural colour. The veins filled ; there was a slight general warmth, and every indication that, as a mechanical process, the artificial circulation was complete, and that the establishment of artificial circulation of blood in the human subject is a process as possible as the establishment of artificial respiration.

A skilful surgeon would find no difficulty whatever in injecting by the brachial or the femoral artery ; the operation being in itself no more than that of cutting down upon it, and inserting a tube into it, for the injection of a preservative fluid in the art of embalming.

Artificial Circulation by Electrical Excitation.

Electricity, in the form of electro-galvanism, was employed in many instances, after death by chloroform, in order to restore the circulation. The current, in these researches, was governed by a metronome, so as to regulate the shocks, and to make them tally with what would have been the rate of the natural pulsations of the heart. At the same time artificial respiration was maintained, so that any blood which might pass over the pulmonic circuit should be duly charged with oxygen. For some of these inquiries I devised an instrument, made for me by Messrs. Krohne and Sesemann, by which a double-acting bellows was so connected with the electrical moderator that four discharges from the little battery were delivered to the heart to one inflation of the chest with air from the bellows. In one of these trials, after the animal had been dead from chloroform for ten minutes, the negative pole from the battery, insulated except at its blunt probe end, was passed along the vena cava into the right heart, while the positive pole, armed with a small portion of sponge, was placed over the heart externally. The discharges from the little battery were then rhythmically delivered, while the artificial respiration was kept up in proper time. After a very short period the heart on both sides contracted in correct form, and the pulmonic current of blood was made. In turn, the systemic circuit was made, with natural pulsation of the arteries, muscular irritability, and so many signs of reanimation that I once more stopped the proceeding to prevent a possible restoration of conscious life. In repeating this process with the poles of the battery reversed, and the outer pole on an intercostal space over the heart, instead of on the heart directly, no result at all was obtained in regard to the heart, although the muscles of the thorax responded to the electrical current.

Practical Inferences from the Research on Artificial Circulation.

It should be specially remembered that every experiment related above on artificial circulation was made on an animal actually dead, in the common acceptation of the term, and when a considerable period had elapsed after all manifestations of life had ceased. They were tests of the extremest kind in regard to reanimation.

I gather from them four inferences :—

1. That resuscitation under the conditions of suspended life,—now often practical death,—in which the body is not mechanically injured, nor structurally diseased, nor charged with a fixed poison, may, in course of patient investigation, become a demonstrable fact of modern science. I am indeed fully prepared to believe that this may take place before the close of the present century.

2. That the forms of death in which the restoration of life will be possible will include a large class, such as (*a*) various forms of sudden death from anæsthetics, from choke damp in mines, from mechanical suffocation. (*b*) Deaths from drowning, and especially deaths from drowning in very cold water, as in immersion under ice, in which the suspension of life is extremely prolonged. (*c*) Sudden deaths from shock or stun. (*d*) Deaths from sudden and profuse loss of blood.

3. That the mode of procedure will be by artificial respiration, combined with one of the three methods of artificial circulation above described, or by some modifying combination of them.

4. That the great obstacles to success which have to be met are: obstruction to the circulation by coagulation of the blood; aggregation of the blood-corpuscles in the minute vessels; contraction of the capillaries; the occurrence of *rigor mortis;* and the intervention of putrefactive changes commencing in the blood. But, that these difficulties are probably surmountable by the scientific use of one agent, which suspends them all, and holds them in abeyance,—extreme cold.

Resuscitation from more Temporary Forms of Suspended Life.

Returning to the class of instances of suspended life in which transfusion of blood from one animal to another seems to have led to recovery, I would remark that while to all, except the very few who have studied the subject practically, these instances look as much like illustrations of resuscitation from death, as if death had actually occurred, they are not really cases in which all vital action has ceased.

In order to explain this point I must refer to my

Croonian Lecture, delivered before the Royal Society on May 9th, 1873, on "Muscular Irritability after Systemic Death." In that lecture I showed that the heart may work under two degrees of tension: one the high or vital tension, the other the low, suspended, or syncopal tension. Under the high tension all the acts which visibly demonstrate life are carried on; under the low tension the common signs of life are absent, and yet there is just sufficient motion from the centre to support a mere passive existence which is akin to death, but is, in fact, smouldering life.

After great loss of blood; after profuse choleraic discharges; during exposure to extreme cold; during the action of some volatile chemical substances;—this life at low tension may go on not merely for hours, but for days, nay, weeks, under the similitude of death, and may be attended with ultimate restoration to life, induced by the most elementary means of restoration.

I have seen this many times. I have witnessed a case of catalepsy in man in which, at one moment, neither I nor my medical brethren were quite sure whether the body was alive or dead; and yet recovery proved that the condition was one of life under low cardiac tension.

Some carp were once sent to me from Newcastle-on-Tyne, in the frozen state, and surrounded by ice in which they had been firmly enclosed. They had been accidentally frozen in a tank. To all appearances they were as dead as the ice itself, and they were reported to me as having been many days in this condition. But, by cautious thawing, with care that he glacial condition of the animal should not pass into the pectous colloidal or coagulated condition, I restored seven out of eleven to healthy activity.

Dr. Murie, when he was at the Zoological Gardens, was good enough to send me a tray of fish, frozen during a sudden frost in a kind of thick mud at the bottom of a pool, for my lectures on death by drowning and cold. These fish I restored to life in the same way.

In my Croonian lecture at the Royal Society, four toads that had been frozen in a block of ice were reanimated with equal ease, although they were so condensed and hard that they were more like stone than animal structures when they were removed from the ice.

Mr. Warrington's observation of an animal which remained for several hours apparently dead from the effects of hydrocyanic acid, and which afterwards recovered, is an example of the suspending power of one well-known chemical poison. That, however, is minor compared with what I once observed from the action of nitrite of amyl. Under the influence of this nitrite, I witnessed recovery after life had been suspended in the frog for the long period of nine days (*Report to British Association for Promotion of Science* for 1864, p. 124). In another observation on the suspending action of this same substance on the frog, I witnessed perfect recovery after signs of putrefactive change were developed. In every one of these instances there was, I believe, no actual death. The life, although bereft of all consciousness and vital manifestation, was being continued with the circulation at the low tension.

In this condition transfusion of living blood would lead, in some cases, to quick reanimation, and I can fully believe that, after prolonged syncope from hæmorrhage, such transfusion might induce a reanimation which would look like raising the dead to life.

COTEMPORARY PRACTICE AND LITERATURE.

> "*Every physician will and ought to make observations from his own experience; but he will be able to make a better judgment and juster observations by comparing what he reads and what he sees together.*"—FRIEND.

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RENAL AND URINARY AFFECTIONS.

IN a volume of six hundred and ninety pages, Dr. W. Howship Dickinson publishes, through Messrs. Longmans, his latest contributions to the study of renal and urinary affections. Dr. Dickinson is the continuous type of a class of physician, author, and acknowledged master in medical science and art, now passing out of history; namely, the minute clinical investigator and teacher, equally at home at the bed-side, in the post-mortem room, at the lecture table, at the desk, when engaged in describing symptom, diagnosis, prognosis, pathology, morbid anatomy, and,—after the fashion of his school,—treatment of disease. Students of a date even as late as a quarter of a century ago knew and acknowledged no other style of master, and there hangs about him yet a deep, if a more silent, respect; an admiration for his industry, his minuteness of observation, and his perfect truthfulness. The volume now noticed is a remarkable illustration of these traits of mind. It would be difficult to find a volume in all medical literature in which more genuine and conscientious labours are put together. The illustrations, of which there are many, are carefully devised and excellently drawn, while the text is so clear that he who runs may read. Chapters XI. and XII., on renal calculi, ought to be studied, with double reading, by all who wish to gather up quickly and surely the latest knowledge on the subject. The last section of chapter XI., on the differential diagnosis of renal calculi, although not filling two pages, is a summary which few men could write, and none with a lesser knowledge than that possessed by its learned and accomplished author.

PRINCIPLES AND PRACTICE OF MEDICINE.

A LARGE volume, entitled "Lectures on the Principles and Practice of Medicine," comes from the pen of Dr. Nathan Smith Davis, of Chicago, and is published for him by Messrs. Jansen and McClurg of that city. In many points of view these lectures correspond in style and quality with Dr. Dickinson's essays, but a much wider field of disease is traversed. Indeed, they embrace, substantially, the course of instruction on the principles and practice of medicine given by their author in the medical department of the Chicago Medical College, and present those views and modes of practice which have been developed in his own mind, as a result of fifty years of constant devotion to the study and practice of the healing art, on a field amply sufficient for both scientific study and direct clinical observation.

The volume altogether is of exceeding value, and I confess I was not aware that the profession in America had given forth so comprehensive a work on practical medicine, excepting always Professor Palmer's admirable volumes. Those medical men who are beginning to look at both sides of the shield on the question of the value of alcohol in disease may turn to p. 870 of Dr. Davis' book with much interest. In a paragraph in this page the author says that after thirty-five years' experience, with every means of testing the effects of alcohol on the heart in cases of low febrile disease, he has come to the conclusion that he has never yet found an instance in which it—alcohol—increased the cardiac force or the efficiency of the general circulation. But he has seen many cases in which it has so impaired the vaso-motor influence as to greatly increase passive congestion of the lungs and other vascular structures, and that, too, while its anæsthetic influence, in quieting restlessness, caused the patients to say they were better, even up to the time of relaxation of the sphincters and the occurrence of involuntary discharges. The observation here rendered is a good illustration of the method of the author throughout. There is a great deal that is original, and the whole is, with freedom from all pretence, instructively pointed, and eminently practical.

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SWEATING TO DEATH.

DR. MYRTLE, of Harrogate, has done well in publishing a carefully prepared report, in the *Medical Press*, February 25th, 1885, of a case of sweating to death. The patient was a hale man of seventy-seven up to February 14th, 1882, when, after some flying pains, followed by fever, he commenced, about the 8th of March, to perspire in the most profuse manner. From that time up to the 15th of June the profuse perspiration continued despite every means, based on every possible hypothesis as to cause, for his relief. For a short time arsenic, as a medicine, seemed to be of most service, but that suddenly failed, like all other remedies, to produce a curative restoring influence. The sufferer ultimately sank from exhaustion, perspiring to the end. He retained his mental faculties until the last.

The case is one of extreme rarity. In my student days, I should say in 1846-7, there occurred at the Royal Infirmary in Glasgow a death from sweating sickness, but in so far as I remember the symptoms were acute, as in the epidemic of sweating sickness in the time of our Henry VII., the death following within a few days after the commencement of the symptoms. It would, however, be worth the trouble to look up the details of that case if they have been kept. This is the only instance of the kind I can recall from personal knowledge in which general sweating was a cause of death; but I have more than once seen extreme perspiration continuing for long periods of time from limited parts of the body. One gentleman has, within these last few years, been twice, during my morning clinique, to consult me respecting a profuse and constant perspiration on one side of his head and face. On each occasion the fluid literally streamed from the affected surface, which, as he said, using the very words of Dr. Myrtle's patient, "was soddened by it." Here arsenic rendered a distinct service both times, and if I dare venture to use so dangerous a word, I should say effected a "cure." In another instance, a woman under the care of the late Dr. Robert Willis and myself suffered from what we called hemi-erythema. The whole of the right side of the body was affected with a deep scarlet or erythematous blush, with a sharply defined median line in the fore and back part of her body. After a few days there was profuse perspiration over the whole of this surface, attended with extreme exhaustion. The patient suddenly sank from the separation of a large clot of fibrine in the right ventricle of the heart, to the obstruction from which, and not to the sweating, we attributed the collapse.

A LIFE ASSURANCE PRIMER.

A PRIZE of fifty guineas, offered by the Directors of the Briton Life Assurance Company for the best life assurance primer, was gained by P. J. Thompson, L.R.C.P., M.R.C.S., of Brussels, and is now published in a very neat and handy form by Messrs Baillière, Tindall, and Cox, of King William Street, Strand. The essay includes a history of life assurance in England; classes of life assurance companies; life or mortality tables; mode of calculating premiums; selection of lives; invalid lives; legal aspects of life assurance; and many other topics equally important. The author takes care to indicate how greatly the responsibilities of the medical advisers to the insurance companies have increased of late years, and points out their duties clearly and concisely.

STANDARD PULSE READINGS.

AN ATTEMPT TO READ SPHYGMOGRAPHIC TRACINGS FROM A NATURAL STANDARD, BY A STEEL-YARD BALANCE AND AN AUTOMATIC PULSE-METER CHART.

◆

SOON after Dr. Pond, of Rutland, U.S.A., introduced to the profession his beautiful new sphygmograph, I essayed so to adapt it as to get from it a standard by which all who are engaged in sphygmographic work could read their tracings methodically. Later on, when Dr. Dudgeon's improved instrument came into use, I pursued the attempt with it; and now I have so far advanced as to be able to bring forward the first results of the inquiry.

For all writing purposes, and for perfect conveniency, Dr. Dudgeon's sphygmograph may be taken as well-nigh perfect. What I found wanting in it, as in Pond's, and what I have attempted to supply, have been the means of applying, accurately and easily, the pressure upon the pulse, and of registering the reading so as to be able to obtain a natural standard, I mean a standard from a natural pulse, that will determine, from one uniform reading or constant, all unnatural or morbid variations, and will be worked automatically.

THE STEEL-YARD BALANCE.

To effect the weighing part, or the means for determining the pressure, I got Mr. Krohne,—of the firm of Krohne & Sesemann, who has rendered me the most useful aid in this work,—to remove from my Dudgeon's sphygmograph the pressure-gauge devised by its inventor, and to introduce instead a steel-yard balance, which projects as a weighing bar from the fore part of the instrument, as shown in the diagram (Fig. 1).

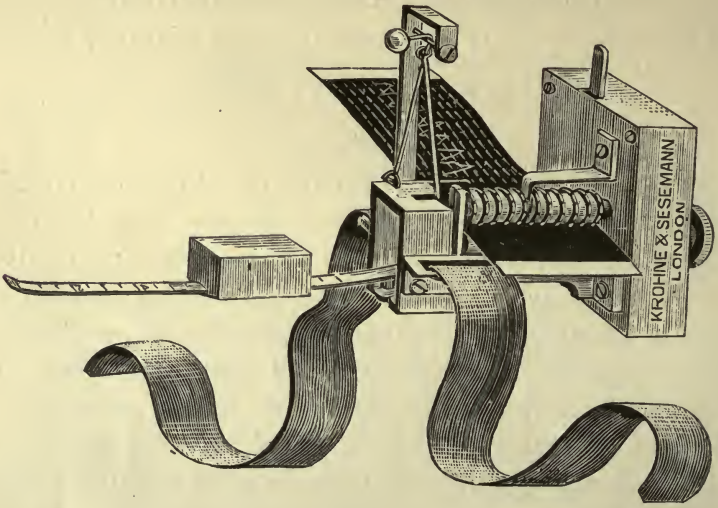

FIG. 1.

The bar, which is carefully graduated, will weigh from one ounce to six ounces. The weight, which moves along the bar, is arranged in the same manner as in the instrument for measuring time in music, the metronome, and can be made to glide from one degree to another with the utmost ease.

In weighing the pulse with this balance, the sphygmograph is placed on the wrist in the usual way, and, when the pulse is found, by the regular movements of the needle on the recording paper, the weight is gradually moved up and down the scale, until the balance between the pressure which holds the instrument firmly in position, and the pressure exerted by the steel-yard, is precisely determined. Then the recording paper is allowed to traverse the stage under the clockwork action, and the record is written off by the needle.

As a general practice, I take the reading at first with a three-ounce pressure from the balance. But I never omit to test the full pressure later on. I fix the instrument with my left hand, by means of the straps which pass from it round the wrists, so firmly, that I may, by movement of the steel-yard weight, find what is the longest up-stroke that can be obtained. Having found that, I let the recording paper traverse the stage to take the record. For holding the instrument steadily in its position, I use two perforated leather straps of equal length, attached to the instrument on each side. Over these I fit a movable steel clip, which gives great firmness with ease of movement. With properly acquired skill in manipulation, the pulse may be taken by the instrument almost as readily as by the finger itself.

AN AUTOMATIC SPHYGMOGRAPHIC CHART.

I now come to the second, and I think more important, improvement in the pulse-reading process. This introduces a plan by which each record is measured, as it is taken, on a series of vertical and horizontal lines produced on the carbonized paper at the same moment as the pulse curves are written. The plan is as follows :—

The carbonized paper, which traverses the stage to receive the impressions from the needle, and which is moved by the pulse, has hitherto been carried along by the motion of a smooth circular rod or bearing, made to rotate by the clock represented in the square box in diagram 1. Into this revolving bar I have now had set a row of sharp edges, which, in revolving on the carbon, cut a series of lines of equal distance from each other along the whole length of the paper. These lines are so arranged that they leave on the paper ten horizontal spaces, or degrees, each degree two millimetres apart. At the same time, the sharp blades are divided transversely, so as to cut also a series of vertical dotted lines, or degrees, each two millimetres apart. When, therefore, the carbonized paper is made to traverse the stage by the clock-movement, with the needle at rest, it is marked out by a set of measuring lines, horizontal and vertical, upon which the movements of the pulse are written when the needle is moved by it. This constitutes the scale, or chart, on which the standard readings of the radial pulse are taken. In its open form the scale is sketched in the diagram (Fig. 2).

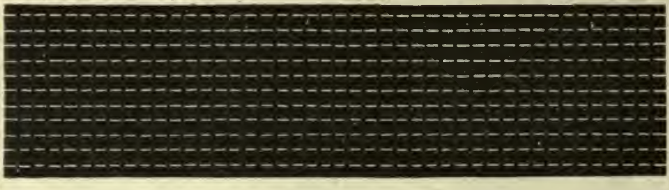

FIG. 2.

In bringing this scale into action, no more preparation is required than for the ordinary paper. The change is effected entirely by the sphygmograph itself, which cuts the carbon, automatically, at the same time that the needle is marking the tracings produced by the pulse. There is, therefore, neither addition of time nor of labour to the operator.

In order to produce the pulse-readings with the measuring scale, the carbonized paper is made to traverse the stage with the needle set in motion by the pulse, after the correct pulse pressure has been found. The result is a reading as shown in the diagram (Fig. 3).

As will be seen, the pulse tracings cross the standard or chart lines, and admit of being accurately measured in respect to the ascending or ventricular movement of the pulse; the first descending movement; the second short ascent; the second short descent; the third short ascent; and the third final descent down to the angle where the next similar series of movements, or, as they are sometimes called, "events," take their start.*

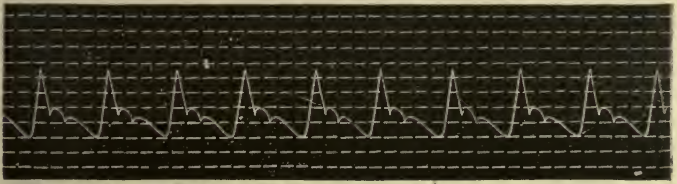

FIG. 3.

This diagram shows the order of movement over the lines and degrees, but it also shows more. It gives, as correctly as I can render it from twenty-five readings of the right radial pulse of healthy persons between thirty and thirty-five years of age, and in conditions as closely natural as it is possible to obtain, the normal pulse standard or constant, while the pulse is lifting the steel-yard weight balanced at four ounces, with the subject in the sitting posture.

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* These tracings of the radial pulse, as I read them, from an attempt to reproduce them by means of an outside mechanism resembling in its action the circulatory movements, are caused in a way the description of which differs somewhat from that usually given. I shall explain this more fully in a future essay; but, tentatively, I may state here that the tracings seem to me to indicate the following order of events: (1) the long ascending, nearly straight line indicates the full pressure of blood from the contracting left ventricle; (2) the first oblique descending line,

Read by this, the scale shows that in the natural pulse the tracings should be :—

Four degrees and a-half, or nine mm., on the scale for the long ascending straight line,—systolic tracing.

Three degrees, or six mm., for the first descending line,—receding ventricular tracing.

Half a degree, or one mm., for the second ascending line,—primary arterial tracing.

One degree, or two mm., for the second descending line,—receding arterial tracing.

Half a degree, or one mm., for the third ascending line,—aortic check.

One degree and a-half, or three mm., for last descending oblique line,—subsiding arterial wave tracing.

In all eleven degrees, or twenty-one mm.

The above are the natural measurements, taken step by step, as vertical and oblique movements. I have next to speak of them as horizontal measurements, and as measurements of time.

The clock in the sphygmograph, with which these tracings were made, is so "set" that the period of

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the decline of the ventricular pressure ; (3) the second short ascending line or curve, the primary arterial recoil ; (4) the second short descending line, the decline of arterial recoil ; (5) the third short ascending line or curve, the check or chuck from the closure and tension of the aortic valves ; (6) the last descending oblique line, the subsidence of the arterial wave, under which the artery is left at rest, but filled with its column of blood awaiting the next charge from the ventricle.

passage of the surface of carbonized paper occupies precisely the sixth part of a minute, or ten seconds. The number of each ascending tracing is consequently the number of completed pulse movements in the sixth of a minute. Let the number of straight upright lines across the scale be multiplied by six, and the rate of the pulse per minute is arrived at, and may be estimated fairly from the number seventy-two as a natural mean or standard. Once more, let it be observed that the distance apart of each upright line, horizontally, is precisely the length of the line itself, so that the space included in a perfected pulse movement, from the first point of impulse to the last point of movement, is a square of four and a-half degrees, or nine mm.

The directions and curves of the descending or oblique line, from the top of one upright line to the base of the next, require a moment's study. The course of the first descent is from the top down to the space between the first and second lines above the base line of all the impulse or ascending strokes, and one degree distant, horizontally, from the impulse stroke; it then curves upwards half a degree and falls, two degrees horizontally from the impulse stroke, on to the line immediately above the base line; it rises again half a degree; it descends upon the same line, three degrees horizontally from the impulse stroke; and finally it curves through one degree, to the close of the circuit.*

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* It may assist the memory to suggest that, if in the reading above given all the lines of the scale were removed except four above the base line from which the impulse stroke starts, and if the five lines thus left were taken as a treble clef in music, the course of the tracings on them would be from E to upper G; from upper G to A below; from A to B; from B to G below; from G to A; and from A back to lower E.

VARIATIONS IN PULSE READINGS.

We will now turn to a few variations of pulse readings from the natural standard, in order to show the application of the standard to practice.

In diagram (Fig. 4) is the reading of a pulse which is not natural. The impulse stroke is one degree and a-half below the standard. The primary descent is one degree and a-half shorter than natural; the first arterial tracing is nearly horizontal in its course; the second decline and aortic tracings are scarcely defined; and the distance between one impulse stroke and another is two degrees longer than the impulse stroke, instead of being of the same length. The number of completed movements in the scale was one hundred and fourteen instead of seventy-two, and the full pressure borne by the pulse was three ounces.

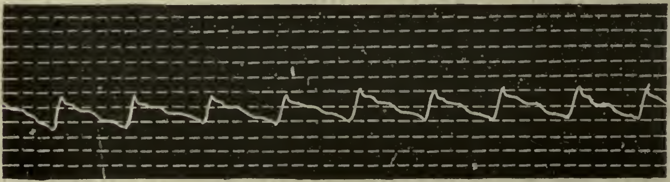

FIG. 4.

In diagnosis, this pulse-reading is one in which the systole is rapid and short; the delivery of blood feeble; the primary arterial recoil slowly and feebly developed, owing to imperfect resilience; the aortic closure and tension weak and deficient; and the number of movements increased nearly one-third per minute.

The case from which the reading was taken was one of phthisis pulmonalis at the commencement of the third stage, in a man twenty-eight years of age, and at a time when his circulation was at its best. The reading is so typical that it almost of itself tells the disease. Feeble heart, attenuated nutrition, relaxed arterial vessels, rapid action.

In diagram (Fig. 5) the conditions are entirely changed. In this reading the impulse tracing is one degree and a-half above the standard; the first descent is irregular; the arterial recoil is sharp and short; the second decline is prolonged half a degree; the aortic line is horizontal; the last descent is prolonged half a degree; and the interspace of the impulse distance, irregular in one instance, is correct in the rest. The number of completed movements was at the rate of sixty-six per minute, and the full pressure of the pulse was four ounces.

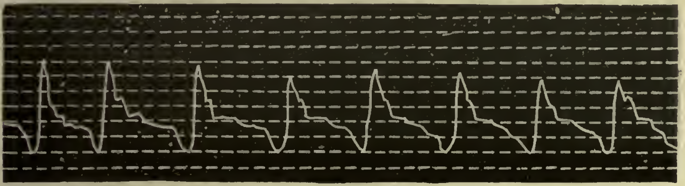

FIG. 5.

The diagnosis from this pulse-reading would be that of a heart slightly enlarged and powerful; a recoil of the arteries upon the aortic valvular surface, sharp and powerful; an aortic closure, not perfected with the first impact of blood; the aortic valves a little unduly distended by the blood pressure on them; the secondary recoil slow and sustained; the circulation slow.

The subject of this reading was a man fifty-four years of age, of very active habits, and in all respects well, except that, now and then, he was "conscious of having a heart by feeling its movement under excitement, and of experiencing a sensation of a slight irregularity."

In diagram (Fig. 6) the impulse stroke is, at its best, two degrees short, while the other events connected with the oblique descending course are scarcely definable; the impulse distances are equal, but nearly three times as long as the impulse itself. The rate of movement was seventy-four per minute, and the full pressure of blood was three ounces.

These readings, extremely characteristic, would yield a diagnosis of feeble heart; feeble arterial recoil; slight pressure on the aortic valves; a prolonged and feeble secondary recoil; the number of heart strokes per minute natural; and the motion equal.

The reading was from a man of middle age, who, in fair health generally, and of light build, suffers severely, and has suffered from his first days, with feeble circulation, cold extremities, and, when the weather is wintry, from chilblains, a condition which, as indicating a long range of similar cases, might appropriately be called cases or conditions of *chilblain circulation.*

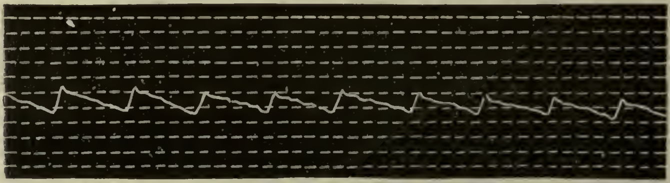

FIG. 6.

In diagram (Fig. 7) there is a reading of a striking character, in which, as will be observed, there are a number of major and minor impulses. The impulse is sometimes through five degrees, at other times two; the primary arterial tracing is irregular and feeble; the third ascent, from the aortic check—sometimes single, sometimes double—is variable from one and a-half to two degrees, and the impulse distances are unequal. The rate of movement was one hundred and twenty per minute, the full pressure three ounces.

The diagnosis in this case would be intermediate intermittency of the heart from mechanical valvular impairment, probably mitral regurgitation; weak arterial tension; rapidity of stroke; and variability, due to irregular contraction of the left ventricle.

The reading was taken from a gentleman sixty-four years old, who was in good health, except for the cardiac disturbance, called by him "constant palpitation," and produced, as the stethoscopic signs indicated, by regurgitant mitral disease.

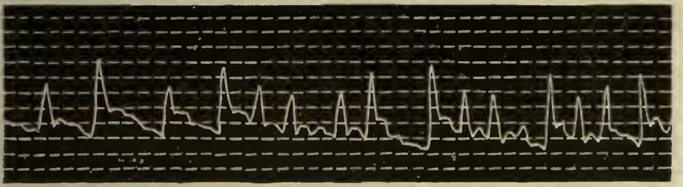

FIG. 7.

I shall have opportunity in future to enter into many other details of pulse-readings from the standard method above described. It is sufficient, at this moment, to explain the principle on which that method is based, and the readiness with which it may be applied. I trust it will bring the art of sphygmography, or pulse-reading, to such a precise bearing, that practitioners who adopt it may be able to record their observations with the same readiness and exactitude as they now record the varying temperatures of the body during disease, from the standard temperature of health marked on the clinical thermometer.

HOMELESS AND NOMADIC POPULATIONS: THEIR SANITARY CONDITION AND INSPECTION.[*]

◆

YOU have invited me to speak to you on some sanitary question. I am very happy to comply with your wish, and I trust you will not think I am taking an unfair advantage of your kindness when I tell you that, instead of endeavouring to communicate any new fact or information that might be directly of advantage to you, I am going to ask you to undertake for me a service which you, of all men, can best render.

Let me state at once the motive that calls for the service, and the nature of the service itself.

There are in England and Wales, the sphere in which you labour, three classes of persons, called respectively (*a*) Vagrants, (*b*) Itinerant Salesmen (like the Cheap Jack fraternity and Showmen), and (*c*) pure Nomads, like the Gipsies. These are all, in the ordinary acceptation of the term, homeless people. They live under conditions extremely different from the rest of the community. With them sanitary laws, as we understand such laws, are practically unknown.

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[*] Address to the Association of Public Sanitary Inspectors. Delivered April 4th, 1885.

These homeless and nomadic populations are so distinctive, it is important for us, as sanitarians, to know to what extent they differ from the rest of the community in the matters of health and longevity.

Have they, owing to their exposure to the vicissitudes of want and bad weather, a heavier calendar of disease, greater physical suffering, a higher mortality, than the other parts of the population? Or is it possible that, owing to their enforced avoidance of some of the pleasures and luxuries of their civilized brethren, they are saved certain of the penalties incident to civilized degeneracy?

THE VAGRANT CLASS.

It is difficult to determine what, at the present time, is the population of the pure vagrants, of those who live entirely by begging from door to door without belonging to the itinerant or to the nomadic group. The vagrant is of a class that is, I believe, decreasing very fast every year, and as the members which constitute it usually find their way into the workhouse, as their final destination, their fate for the last part of their lives is recorded there.

At the same time we require more observation and inspection of them while they are at large. They live in the most irregular manner, and they frequently sleep, night after night, under the most different of conditions. One night they find a bed in a workhouse, another night in a common lodging-house, another night beneath any rick or shed which will afford them shelter. They take what food they can get in much the same uncertain form. They pick up a fair amount one day, they starve the next, and they take their meals with very little regard to regular times. As one of them told me, "We eats it as we gets it, master, like the cows and sheep, and we are glad on it." This was and is a fair definition of their mode of taking food. Their clothing is, usually, scanty, devoid of change, and always dirty. Their bodies know little of the good influence of pure water. Some of them are intemperate, but not all. The majority, I fear, drink when they can get anything to drink, their great predilection being for beer, but some are by choice as well as necessity water drinkers, and these live better than their fellows, with whom they exchange food for beer or other strong drink. In an inspection which I once made in the East End of London, with one of the members of your own body, who was good enough to chaperon me, I offered to spend a small sum for the feeding of a certain number of the neediest vagrants who had come to a lodging-house for shelter, and I was surprised to find how many of them wished to have coffee in preference to any other drink. Coffee, a rasher of bacon, and a roll of bread seemed to them to be a perfect banquet.

I have sketched out here in broad lines the usual life of the vagrant class as it still exists. What I would like you, gentlemen, to observe and record is the effect of this mode of life on the health, and strength, and longevity of those who belong to the class.

What are the more common diseases of this community? Is consumption of the lungs common amongst them? Are the contagious febrile diseases common amongst them? Is the parasitic disease known as scabies, or itch, still common amongst them? Is ringworm of frequent occurrence with them? Do they suffer more than the rest of the community from tapeworm and other forms of the entozoa?

Or again, are they, more than the rest of the community, the victims of chest diseases, like bronchitis, pleurisy, or pneumonia (inflammation of the lungs)? Is rheumatism a common disease amongst them? Is heart disease a frequent malady, and do many of them die, suddenly, from heart disease? Do they, in large numbers, succumb from diseases incident to starvation or deprivation of proper food, such as diarrhœa and remittent or famine fever?

These questions relate to the vagrants themselves, but the inquiry deserves to be extended very much further in one special direction. It is most important to ascertain how far this wandering vagrant community becomes the medium for the conveyance of infection from one part of the country to another, and from one member of the community to another. The inference would be that vagrants were the commonest bearers of infection. They constantly wear the cast-off clothing of persons who have been the sufferers from the infectious diseases. They pick up, for wear, whatever comes to hand without inquiry, and with no preparatory cleansing; and they sleep, often, in the same apartment with other persons in the clothing which they have worn during the day.

One would expect to find that these vagrants are persistent carriers of infection, foci of disease, from which every class of infectious malady would have its frequent distribution. And yet I believe they are not commonly such carriers. When I, a year or two ago, was making a sanitary inspection of Brighton, I entered with the utmost care into the question whether the common lodging-houses there led to the introduction of the various zymotic affections by these wanderers. The houses were not particularly protected against such diseases. The bedrooms in many instances ran the one into the other. The rooms, as a rule, contained more than one bed, often three or four or more beds; the rooms were usually well filled, and at race and holiday times the sanitary inspector had to be on the watch at every moment to prevent overcrowding.

And yet there had not been, for years past, any instance of epidemic originating in those houses. The schoolroom may be a focus of disease; the school-child may be a carrier of disease. The vagrant and the vagrant-child, less cared for, less free, as one would think, from danger, was, according to my experience, so exceptionally a carrier that I could gather no proof of propagation by its means.

The same results attended a long and careful inquiry in the Lancashire districts, when I was engaged to report on the health and disease of the districts in which alkali manufacture is carried on, districts which are not exempt from zymotic outbreaks disseminated from house to house by personal communication.

I have also at various times, during vacations and during visits in the large towns of the kingdom, for the purpose of collecting facts for medical history, inquired, with much pains, as to the condition of this vagrant class and their special diseases. The result has been to find that, as a class, they are not subjected to any special danger or injury from disease. I do not think they live to a great age, although some exceptions are to be found even to this rule, but they share a degree of moderate health equal, to say the least of it, to that of the lower trading and hard-working communities of the great and closely-packed centres of human beings.

In hospital and dispensary practice I met scarcely ever with any of the vagrant class seeking advice there.

THE ITINERANT SHELTERED CLASSES.

If we turn from the vagrant class to those whom I have called the itinerant trade and showman class, the persons who travel from one part of the country to the other,—like those who sell wares of various kinds and carry them in a van, which is at one and the same time a warehouse and a living house,—we discover a mode of life very different from that of the vagrant class. The itinerant trader and showman is much better clothed than the vagrant, much better fed, and, according to the ordinary view of things, much better housed. He has in his van a warm and, as he thinks, comfortable sitting-room, which room, by a little sleight of house-wifery, is quickly turned into a bedroom that will sleep father, mother, and three or four children, without any exposure to autumn fog, winter cold, spring-time east wind, or summer rain.

These people are fairly provided for while travelling about from town to town and from fair to fair. They are generally successful in their bargains, and comparatively happy in their work.

But when we come to study their lives in relation to their conditions of health, we discover that, as a general fact, they are not healthy.

They are not healthy-looking, and their children have usually a pale and oppressed cast. They suffer from scrofula, and amongst them consumption is a common disease, if I may judge from the number of them who came before me during the fourteen years in which I acted as physician to the Royal Infirmary for Diseases of the Chest. During that time I rarely was without one patient, at least, derived from this class, and sometimes I had more than one from the same van.

I have recorded in my work on "Diseases of Modern Life" one remarkable instance in which a man, by business a hawker, or "Cheap Jack," who,—accustomed to live, with some other members of his family, in the van in which he travelled from town to town, and from which he sold his wares,—was brought to me in the third stage of pulmonary consumption. He soon died from the disease, and was succeeded in business by his brother, who followed precisely the same line of life, and who lived in the same van. The brother also became consumptive and died. He, in turn, was succeeded by his sister's husband, who shared the same fate; and, not to extend the narrative to an undue length, in the course of seven years I had before me no fewer than nine victims of that fatal pulmonary disease, in every one of whom it showed itself in that particular travelling van. The sufferers argued that they were constantly in the open air by day; that they got regular change of air; that they were not exposed to wet; and that at night they were very snug. In fact, they would not believe that the circumstance of their living and sleeping in the van-house had anything whatever to do with the disease. We have, however, the best evidence that when persons do live in these pent-up rooms, consumption is developed in those who are disposed to acquire it, a fact which may be admitted without any endorsement of the now fashionable hypothesis of the contagious character of the disease.

I have inquired just sufficiently into the lives of this class of the people to have an inkling of their physical condition. I know that they are generally unhealthy; I know that intemperance is a cause of much suffering amongst them; and I am aware that they suffer from other diseases of the chest besides consumption, such as congestion of the lungs, asthma, and bronchitis. At the same time I think they are less subjected to zymotic diseases, such as measles, scarlet fever, whooping-cough, small-pox, erysipelas, than residents in houses are; and I have never once been able to hear of a case of typhoid amongst them, or of typhus. I do not recollect a case of cholera as ever occurring amongst them. But on all these points more extensive and precise information is what I am anxious to obtain, through the wider observation which may be called forth by this essay, and by your regular sanitary inspection in the future.

THE PURE NOMADIC CLASS.—TENT-DWELLERS.

I come now to those members of the houseless or homeless community whom I have denominated the nomadic, and who are chiefly represented by the people known as gipsies. How many there are of this race in England at the present time we do not know, for in our tables of the census they are mixed up with the vagrants, many of whom are not gipsy by race. How many of them live in towns and villages, how many in tents, is not known, nor does it here affect our argument to know, because I am treating merely with the tent-dwelling part of them, in respect to the physical health of that part in particular.

From my earliest days in medicine I have made the gipsies a study. Before I was qualified I was for two years visiting assistant to a medical practitioner in Essex, where there were always numbers of gipsies encamped. I was constantly riding past their encampments. I once attended one of their women in her accouchement. I now and then advised them for trifling ailments. Thus I got into the way of learning a great deal of their mode of life and character.

After I became qualified I settled down for a time at Mortlake, near to Barnes. One night a gipsy fetched me to Barnes Common to see his youngest boy. I found the mother, and sisters, and brothers wailing over the boy in the most piteous tones, in which the father soon took part.

The poor boy, a lad of about eleven, while unharnessing the donkey from the cart, got a blow in his back from the pointed end of one of the shafts of the cart, and had his spinal column fractured at the lower part of the dorsal division. He was thus left paralyzed in the lower part of his body, and so he remained for many months, dying at last from slow exhaustion. While he remained alive I visited him two or three times a week, except for a short period, when he went to a London hospital, the confinement of which he soon found intolerable. By these frequent visits and the medical and surgical assistance I was able to render, in order to make the life of the poor youth bearable, I grew, if I may so say, quite on friendly terms with the gipsy fraternity. I learned a little of their language, and I made regular inquiries as to the diseases to which they were subject. The evidence quite astonished me. They suffered rather extensively from rheumatism affecting their limbs, not acute rheumatic fever but the more common form of rheumatic pain without fever, and when that was said the history of their chief enemy, in the way of disease, seemed to have been told. To what is called common cold they were little susceptible. Of the disease consumption, as occurring in those who lived in the tent, they knew nothing whatever, neither did they appear to suffer from chest diseases generally. Of the zymotic contagious diseases they knew little. They were not vaccinated, and yet I could not trace that small-pox spread amongst them, neither did I meet with any of them who were pitted with small-pox. From typhus and typhoid, measles, scarlet fever, diphtheria, cholera, they had an exemption so remarkable that if it were not perfect, it was so near to it as not to leave any marked impression or memory of it upon them. In 1850 a coachman's child brought scarlet fever into Barnes, and the epidemic, starting from one centre, spread rapidly through the village, through Mortlake, and on to Putney, lasting many months. I was myself a sufferer from it. I know from the great number of cases which I and my friends Dr. Willis, of Barnes, Dr. Whiteman, of Putney, and others of my medical brethren had under our care, that in the houses around Barnes Common the disease had the most extended sway. In a house opposite the weir, or pond, on the common, I had under my own care four children at one time with the fever. In a word, the Common was environed with the disease, but it never touched the numbers of nomadic adults and children that were encamped there, not one of whom, as far as I could ascertain, was protected by having had the disease previously, and not one of whom took the slightest precaution to avoid exposure to the contagion. As a matter of fact, they did not understand the danger, nor care anything about it. Precisely the same freedom and precisely the same indifference were observable in Essex when small-pox was prevalent in one of the districts near which many gipsies lay in their camps.

Still more remarkable is the circumstance, I believe perfectly correct, that amongst these people in their pure nomadic condition the contagious disease syphilis is unknown. There were then, and probably still are, numbers of their men who do not know of the existence of that disease; and I am bound to say that I have never seen either amongst the men, the women, or the children of the true camping brotherhood, an eruption of the disease either in its primary, secondary, or tertiary stages. When they migrate into the towns and settle down to the happier influences of civilization the case may be, and perchance is, different. Then it is a case of doing in Rome what Rome does, and getting in Rome what Rome gets; but in the camp away from Rome, big and little, there is an immunity from this one scourge of mankind, which, if it be not complete, is nearer to completeness than in any class which has been under my observation. The beauty of the teeth of the gipsies is alone a sufficient indication of their freedom from the corrupting disease syphilis.

I do not think that the gipsies in their native condition are intemperate. They are social amongst themselves, generous, and attached, without that demonstration of joviality and hilarity which marks too many of their Keltic and Saxon neighbours. They retain their Indian proclivities in some superstitions, and they regard death with singular equanimity, as if it were merely a continued but varied act of life. They are never lonely nor melancholy, but are fond of music, of animals, and of occupation with anything that skilfully employs their hands. Some of them who have left the tent, and through one or more generations have amalgamated with the general community, have become splendid masters in different arts and sciences, their origin from the tent unknown, often, to themselves. I could give some singular illustrations of this fact if my paper had reference to anthropology instead of sanitation.

SUGGESTIVE NOTES.

I have now, as briefly as possible, put before you my own general observation upon the subject in hand; not as anything complete or dogmatic, but simply as a nucleus to which you may add new truths until a really broad and national work has been developed.

If what I have explained be for the moment accepted as tentatively true, we may gather from it certain lessons even now, which are of immediate importance to us in our daily labours.

I.

We may learn that what is commonly called poverty, even when it comes down to destitution, is not, of necessity, a cause of the worst diseases. Poverty may lead to inactivity of mind and body; it may make those who are subjected to it reckless and utterly careless of to-morrow; it may lead to the propagation of a class of life that is worse than useless, not to say irreclaimable; it may lead, nay, it does lead, to a life that is short, feeble, and objectionable. But—and this is the point I wish to isolate and to impress—it does not lead to a life attended by any increase of those acute, and formidable, and feared diseases which medical officers of health are appointed to control, and into the causes of which sanitary inspectors are directed to inquire. Hence, by the process of exclusion in investigating the causes of these diseases, we may exclude poverty, pure and simple, as one of them, except it come up to starvation and actual famine, when it begets its own specific famine fever.

II.

In the next place, we may learn how mighty a disinfectant we have in the open air, apart from any added or surreptitious aid. We see these vagrants and gipsies going about from place to place and mixing with the infected communities; yet so little evidence do they carry with them of having conveyed disease, we are compelled to institute a definite and close inquiry before we can be sure that they ever carry any infection from the infected places which they may visit. We can only suppose in this how powerful a disinfectant the common air is, and how little else there is of disinfecting virtue. I read lately an argument by an ingenious physician, that in districts where the atmosphere is charged with chlorine, or sulphurous acid, epidemic diseases decline and disappear. I went into one of these districts, and in a dwelling near a factory where chloride of lime was being made, and where the air of the place was to me scarcely respirable on account of the chlorine vapour diffused through it, I found four cases of scarlet fever.

I inquired in another district into the mortality from the zymotic affections in an air so charged with sulphurous acid vapour that not a blade of grass would grow in it in proper health, and I discovered that the returns of mortality from the zymotic affections there were the same as in other districts in which no disinfecting gases or vapours had been known.

But the pure air; about that there can be no mistake. In it lies the one and true virtue.

III.

A third lesson that comes before us is, that even in the midst of pure air, under the very canopy of it, we may in our humanly constructed house-traps beget disease—beget it, and entrap it. The itinerant salesman, or showman, or bargeman, who may also be included in the same category, lives, like the vagrant and the gipsy, an isolated life. He often belongs to the vagrant, or to the gipsy race. And yet by that one little petty difference of existence, a van or cabin for a residence, he makes for himself a nest of disease. He cultivates various diseases as easily as another man may cultivate mushrooms. So, in truth, the van as you see it go along the shady lanes and highways may be an experimental case or house, in which the synthesis of disease is proceeding with certain, if not with skilful, design.

IV.

We may gather another lesson by inquiring the reason why the people who do not live in the closed place escape so often from risk. The inquiry shows us that these people escape by escaping from their own emanations. The products of the living decompositions of their bodies are removed as they are produced, and as a result they do not poison themselves. They avoid the exhalations from the breath, many of the odours from the skin, the effluvia from other excretions, and the gases from the decomposing matters of the sewer, the ashpit, the larder, and the scullery of the house. They escape immediate contact with the infected sick. They have no establishments, no sick-rooms, no water-closets, no drains, no concealed dirt, no darkness to contend with.

V.

We gather from the gipsy, in so far as we learn from the facts we have in hand, that his exposure in the tent to the varied atmospheric changes, though it may give to him a comparative early development and short life, to which however there are many exceptions, is not productive of any special form of disease, while it is protective from many of the worst forms. If it be thought that the gipsy is specially favoured by his natural physique, and by his primitive racial vigour, we have an answer to the objection so raised, that the evidence of injuries to his health on his removal from the pure out-door life into the common life in the town and city, is sufficient to indicate that he is no better constituted than his neighbours to meet the common dangers incident to aggregation, since then, like his comrades, he falls into their diseases.

VI.

The final lesson taught us is, how easy a thing it would be for civilized society to keep in health, if that society could be persuaded to accept from the uncivilized a few of the most simple and elementary truths. Civilization, in its strict sense, instead of being opposed to sanitation, is the greatest aid to the highest sanitation. Civilization would give to the vagrant and gipsy a better and healthier life if it were obedient to the most ordinary natural laws. Civilization gives a house, which is better than a tent; a bed, which is better than straw laid on the earth; a kitchen, which is better than three sticks and a tin kettle; a selection of food, which is better than the precarious supply that has to be begged or stolen; together with amusements, instruction, and other supplies for the mind, which are a thousand times better than the grumbling emptiness of despairing destitution, or the haphazard struggle which only rejoices when something succeeds in the war against other men and other social developments.

Why, then, with all these advantages, does not civilized society complete the programme of the best, and give us the civilized life without the evils which, up to this present time, are calling forth a little army of men like yourselves to help to remove?

The answer is, that civilization fails, because of its many blunders over a few elementary rules which the wandering nomad never had the occasion to acquire.

OUTLINE FOR SUGGESTED REPORTS.

Without any reserve, and without the fear of having adduced more than will tend to call forth a considerable public discussion and inquiry, I now, gentlemen, turn to you to explain how you can render great public service in finding out to what extent my views are or are not correct. You are a large body, scattered all over the kingdom; you are engaged every day of the year in reporting on causes of disease; you go where other people do not go; you often get glances at first causes before the learned officers under whom you work come upon the scene. If your minds be directed to any one particular series of facts connected with your department in the inspection of sanitary and unsanitary conditions, you cannot, I presume, miss anything that is very important and that ought to be known.

I venture, under these circumstances, to ask you to record all that you may observe on the subjects now placed before you, and to send your reports to me, on forms which shall be supplied to you, in order that from your wider sphere of observation I may amend my own, and on a future occasion communicate the results of our mutual labour.

THE MIND AS A DIAGNOSTIC SURFACE.

IN the essay on the mental phenomena of typhoid fever, published in the ASCLEPIAD of October 1884, I ventured to suggest that each serious distinctive disease has its own distinctive mental state or delirium, and that if each delirium were carefully observed and written down for reference, there would be gathered together a series of phenomena as specially diagnostic, in their way, as any of the more commonly recognised physical indications.

The word delirium was used as including within it all the special mental aberrations peculiar to the particular diseases. I do not think that a better word is to be found. Delirium, used even in its literal sense, has a sufficient breadth to carry, in its meaning, all that is required of it. It need not be confined to the notion of frenzy; it may include frenzy; but it may also include restlessness, perturbation, depression, or any other special variation or deflection, or any group of variations and deflections of mind.

SOME DELIRIUMS OF CHRONIC DISEASES.

I noticed in the previous paper certain kinds of delirium incident to some acute diseases of the zymotic type, and diagnostic of them. In the present paper it is proposed to touch on the delirium, according to the definition of it rendered above, of one or two of the prolonged or chronic diseases.

Delirium Inquietans.

I open this side of the subject by an observation which has been sent to me by one of our most observant contemporaries, Dr. Clifford Allbutt, of Leeds. Dr. Allbutt, in a kindly appreciative communication of the previous paper, has directed my attention to a peculiar delirium accompanying some forms of heart disease, which has not as yet been described in books, nor taught systematically in the schools. "This delirium may," Dr. Allbutt says, "be associated with any of the more common forms of heart affection, of which the valvular are the most readily met with and observed. In these diseases, whether aortic or mitral, there often appears a delirium in the later stages of the malady, when the patient is almost or quite laid by. The delirium is troublesome, and the subjects of it are often very unmanageable. But the common character of it *is a delirium of place:* the patient longs to be allowed to go home; or he insists on rising from bed, dressing, and going away by rail; or he is incessantly posted about in a carriage or coach; or he is in some new bedroom, house, or inn, and begs to be restored to his own chamber. I have now watched this delirium so often that I may say that such delirium, though by no means confined, strictly, to chronic heart disease, is most characteristic of it."

To this delirium, so tersely and faithfully depicted by Dr. Allbutt, I should suggest the name described above, *Delirium Inquietans.*

Delirium Dubitans.

To the delirium of place may be added another, also connected with cardiac disease, the delirium of doubt. I have more than once, in less specific but yet clear terms, invited attention to this aberration as connected with *intermittent action* of the heart. In every case of confirmed and well-marked intermittency I have met with the variety of mental variation or deflection now about to be described. The mind is uncertain, and in perpetual hesitancy. If a work of any kind, mental or physical, has to be carried out, it is carried out with no firmness of purpose, no sharp decision that remains satisfactory. The will may be excellent, the determinations sudden; but the will has no stay in it, and the determinations no decisiveness. The mental power is, in fact, as fitful and irresolute as the motion of the heart itself. Friends of such patients say they are as changeable as the winds, and that, wanting in resolution, they never completely accomplish anything which they take in hand. The self-knowledge of these facts, the correlative knowledge that other persons, it may be of lower intellectual but steadier physical powers, are passing rapidly before them in the race of life, brings upon these sufferers the most painful depression, mixed, according to their disposition, either with peevish self-deprecation, or bitter but fleeting criticism and dislike, extending to hate, of men more powerful physically, and therefore more successful. These sufferers are often the carping dismal critics of society; men of whom it is said that no one knows what they will do, which is only too true, seeing that in their delirium they do not know themselves from hour to hour. They sometimes glide into a form of helpless melancholy, and occasionally, in a moment of impulsive despair, either really commit, or try to commit, suicide, for even this may not be boldly and decisively devised and carried out. The nutrition, generally, in these sufferers, is imperfect, and their lives are very unhappy. Towards them stronger men and stronger minds can never be too forgiving nor too merciful.

They frequently inherit the peculiarity of cardiac impairment of function upon which the delirium depends; in childhood they often show the aberration, which, not being then understood as arising from a physical cause, may be much intensified by the harsh methods or punishments that are resorted to for the cure of it.

This mental state as a peculiarly diagnostic symptom, I should name *Delirium Dubitans.*

Delirium Sperans.

In wasting diseases the mental variation is often extremely distinctive and diagnostic. In phthisis pulmonalis the mental state, as many authors have observed, is often one of hope to the end of the chapter, and if it be not invariably so, is rarely one of despair. The spirit of the patient is sustained, as the friends usually express, after they have no hope, a sustainment which to the minds of the lookers-on may amount to the delirium of hope, that is to say, to a hope of which there is no probability, a hope which may be in direct contradiction to the knowledge and common-sense of the sufferer. In the year 1874 I met, at a small dinner of literary men, a writer who has left behind him what will probably be considered one of the greatest books of the present century. He had just returned from abroad, was full of strong vivacity and humour, but was looking worn. During the dinner he expressed a desire that I would ride home with him; and in the course of the drive he communicated to me that he had spat a little blood, and, with a flexible stethoscope, had detected crepitation in the apex of his left lung. As he had been brought up to medicine, he had himself no doubt as to his state, but proposed to come to me next day for "confirmation of his diagnosis." Unfortunately, I could do nothing less than confirm, for the tubercular change was further developed than he had detected, and he was, as clearly as possible, fatally stricken. He knew the fact as well as I did, but it never affected his spirits, and never reduced his hopes. He finished writing a short but striking story in which he was deeply absorbed, and, although he wrote against time, that he might finish his book "while he was strong enough," he never failed to speak of it as a work which he should one day see recognised. He laid out plans for journeys in the East, sketched out designs for future books, and, in short, designed work sufficient for a long lifetime, with an exalted enthusiasm which could only be looked upon as delirium; and yet he knew himself to be declining from day to day and hour to hour. More than once he opened a discussion on the question why persons in consumption were so hopeful. Three weeks before he died, I drove him in the open carriage from town to a pretty country village ten miles away. He was so feeble I had to carry him in my arms from his room, and he was so reduced in weight he was to me no burthen. The sun and the air seemed to re-endow him with vitality, and all the way he talked of nothing but the future, and of what he would do and achieve. And so he continued to the end.

I refer to this case as one of the most typical, but by no means exceptional, examples of the delirium of hope. More or less, the same delirium animates almost all phthisical patients, of whom it will be observed by those who study them that they never run wildly after doctors, or remedies, or specifics. Their friends may, but they themselves are often rather bored than pleased by the anxiety that is expressed for them. I have designated this delirium *Delirium Sperans.*

Delirium Desperans.

There is a form of delirium very distinctive, and often connected with local disease of the lower part of the intestinal tube. This delirium, modified in intensity according to the severity or the duration, or the severity and duration, of the disease, varies little in its details. The one characteristic of it is depression, gloom, coupled sometimes with acerbity, reaching to actual dislike of any person, or act, or thing which gives real or imaginary offence. In most instances, the delirium extends to despair, with a recklessness as to life, but without suicidal proclivities, and even a desire to die rather than live, unless relief can be obtained. I have known a patient so suffering express, when there was no real immediate danger, an assurance of his danger which was alarming to all around him, and make preparations for death, which included every arrangement in the disposition of his affairs, even to the details of the funeral.

In another case, where the delirium was as painfully marked, a mechanical cause of the local disease was easily removed, with recovery as a direct result.

The delirium is often produced by hæmorrhoids, by fissure, and by prolapsus, as well as by malignant growth or ulceration. It is not, I think, connected with fistula in ano in the early stages, although it may be when the sinus extends into the canal.

The term *Delirium Desperans* would very well designate this form of mental variation.

COMMENTARY.

I might extend the diagnostic deliriums to those of hypochondriasis, of hysteria, of alcoholic disease through its various stages up to delirium tremens, and to many others. It will, I think, at this point be better to touch, for a moment or two, on the causes of the mental aberrations which constitute the deliriums.

In the case of the acute febrile diseases, the cause of the delirium is active and evanescent. It occurs at a certain stage; it passes away at a certain stage. It is as if, for a time, the person affected had been placed under the influence of some narcotic drug or vapour; and it is quite reasonable to suppose that, for a time, there is developed in the body of the sufferer some toxic agent, which by its presence so disturbs the mental surface as to produce the irregular vibrations which make delirium. This view is supported by the analogies of the deliriums with those caused by certain toxic agents. Thus, the delirium of typhus is very like the delirium produced by methylic alcohol; the delirium of scarlet fever is as closely allied in phenomena to the delirium caused by atropine as the rash of the fever is to the rash caused by the same alkaloid; the delirium of small-pox is like that which can be produced by inhaling sulphur-alcohol (mercaptan) or ethyl sulphide.

Even in some diseases, which are of a more permanent character, and are not of necessity febrile, the phenomena are very closely analogous to those induced by some narcotic vapours. There are certain forms of hysteria so alike to the deranged mental conditions caused by the vapour of amylene, that it were impossible to distinguish the difference by any knowledge short of the actual knowledge of the cause. The same holds good in respect to the action of methylic ether, which, I may say, does, without any kind of doubt, produce hysteria, viz.: symptoms of sobbing and laughing, which admit of being classified under no other name.

But when we come to the study of many other cases, like those connected with disease of the heart, or lungs, or lower part of the alimentary canal, there is no such an obvious hypothesis in the way of explanation. We have been accustomed to speculate as to whether in these instances the peculiar character of mind may not be due to some hereditary mental quality or taint, linked with the hereditary taint of disease. Under this idea the disease cancer is often supposed to be always attended with lowness of mind, or what I have called *delirium desperans*. In some instances it is the fact that the disease in its course is marked by despair; but in quite as many instances it is not so marked. For several months past I have had under observation a patient dying slowly from cancer of the breast, and, although the pain has been extreme, rendering life an anguish, there has been no sign of despair.

According to my observation, cancer causes *delirium desperans*, or not, according to the part of the body that is invaded by it. When it attacks the lower portion of the alimentary canal, it causes extreme despondency; but so would other disease in the same part. It strikes me, therefore, that, when delirium from organic disease is present, the character of it depends on the organ attacked, not on the character of the organic lesion ; and that the variation which is displayed is from a direct or a reflex influence emanating from the affected part and extending to the mental surface.

In heart disease we can easily understand the attendant deliriums. The disturbance in the central mechanism of the circulation is a disturbance communicated directly to the whole of the mental surface. As when the pressure is imperfect at the main the gaslights are uncertain, so when the pressure from the heart is unsteady and the governance of the blood is deranged, the peripheral nervous function is disturbed and aberrant. It would be impossible to suppose anything else than that a man with an intermittent heart should have an uncertain mind. He is a broken-hearted man in every sense of the word. He is as a man undergoing a series of minor syncopes from minute to minute. He must be faint in action, indecisive, restless, for he has no steady mental sustainment on which to depend for mental endowment and tenacity. Thus, the cardiac deliriums admit of a mechanical interpretation.

The delirium of hope, *delirium sperans*, is not readable in so mechanical a mode. This delirium is like that of febrile excitement under the influence of wine, and is always most decisive when the hectic condition is present. It is probably due entirely to the fitful feverish excitement, the quickness of circulation, the exalted temperature.

The *delirium desperans* is, I suspect, dependent, as a rule, on some interference with the hepatic function.

Its common occurrence, when the obstruction to the return of blood by the hæmorrhoidal veins is interfered with, and when the portal system is engorged, is a pretty clear indication of the primary seat of the evil. In time, as the bilious function is modified, various organic compounds of the sulphur group are easily producible and diffusible through the blood to the nervous centres, over which, as we know from experiment, they exert an influence of the most depressing nature.

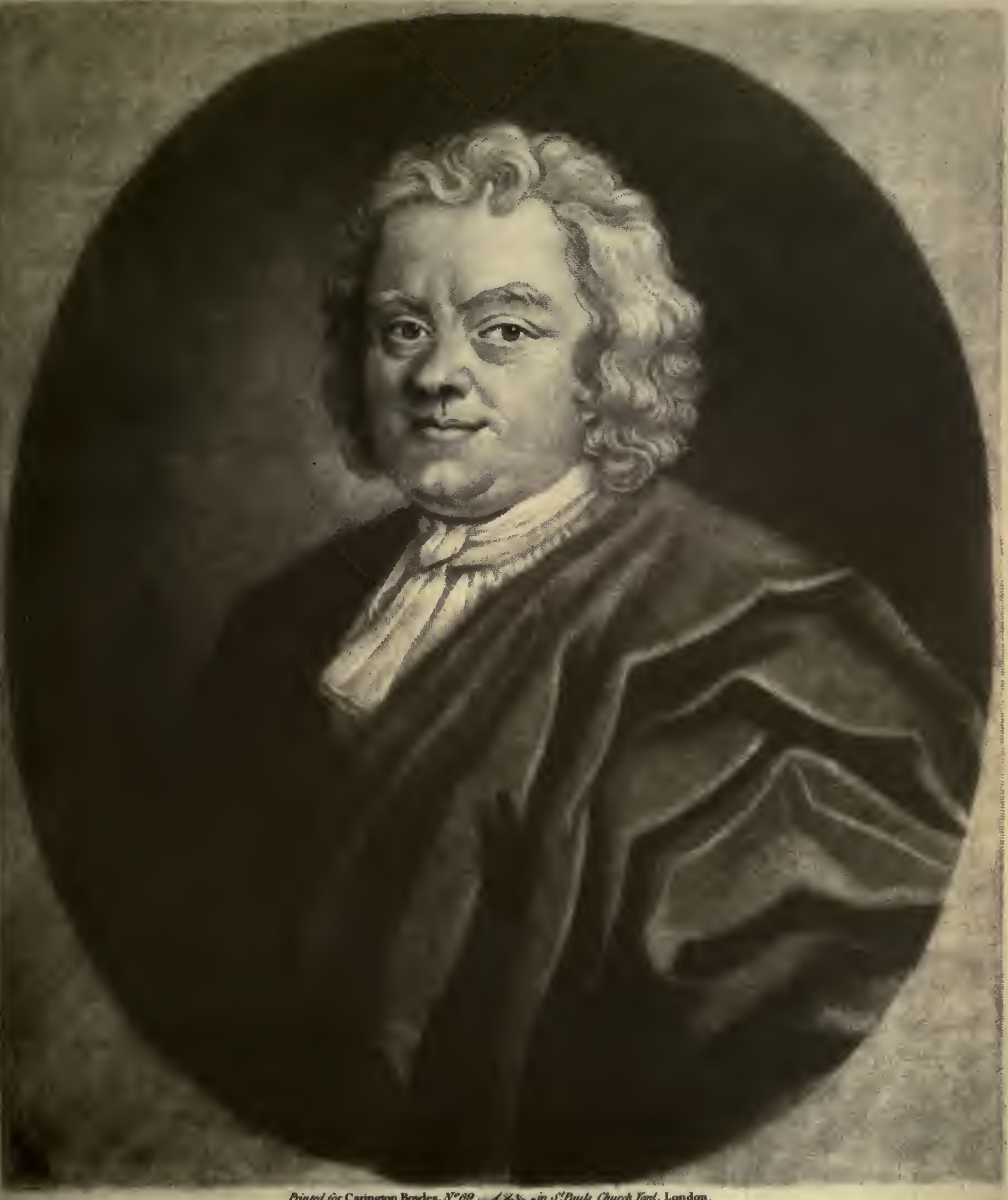
In using the term "mental surface" in the above observations, I have looked upon the mind as a surface laid out on the ultimate constructive elements of nervous matter, as we may suppose an electric atmosphere upon a glass tube, or rod, or plane. On this view we can see how, either by diffusion of an extraneous medium from the blood, or of a disturbance of blood from a mechanical derangement of distribution, we must have aberrations of mind, which, according to the nature of the disturbing influence, will produce mental phenomena diagnostic of the disease upon which that disturbing influence rests.

HERMANN BOERHAAVE, M.D., AND THE ORIGIN OF SCIENTIFIC MEDICINE.

"SIMPLEX sigillum veri," was the motto of the master in physic whose name heads this memoir. It lasted him through a fairly long life, through all reports, good and bad. It was engraved on his tomb.

Whatever work of this master we take up now to read, whatever division of the work, we find in it the spirit of that famous impression. He wrote so clearly that every one could understand him. In the robe of the professor he delivered the teachings of the simplest student. He never shrank from the art of letting himself descend as a teacher to the intellectual level of the taught. For was it not his first principle, *Simplex sigillum veri?*

The firm adhesion to this principle caused the name of this master to be the most widely known and admired of all of his age amongst the masses of the people; the most detested and hated amongst the few jealous pedants who looked on, and were obliged to recognise his popularity. The tradition that a letter addressed to him from the Celestial Empire, and bear-

Printed for Carington Bowles, Nº 69 in Sᵗ Pauls Church Yard, London.

Hermannus Boerhaave Medicinæ, Botanices, Chemiæ &
Collegij Practici, in Acad. Lugd. Bat. Profeſsor Ordinarius.
Regiæ Societatis Londinensis nec non Academiæ Scientiarum Parisiensis Socius.

SIMPLEX VERI SIGILLUM

G. White fecit

18

ing as its superscription the magic words, "Boerhaave, in Europe," found him without difficulty, is evidence of his popularity in the world at large. Once, as he began to recover from a severe attack of gout, he found, when he made his first appearance in the city in which he dwelt, the whole place *en fête;* the bells were ringing merry peals, the houses were decorated, the streets were brightly illuminated. It was all because he, Boerhaave, had returned to health and labour.

These were triumphs, but they were not without their reverses. His views and character, so admired by the many, were assailed with uncompromising anger and bitterness by the not many, who, as is so common under such circumstances, charged him with being what he was not, and of not being what he was. Happily for him, he was blessed with so happy a disposition, that he could let the detractors have their own way and roll in their own impurity as freely as they pleased. He held by the text, *Simplex sigillum veri*, and for his detractors he added another text which he held by with equal tenacity,—"The sparks of calumny are presently extinct of themselves, unless you blow them." A proverb of proverbs. In him an intense zeal lived in concert with a dispassionate judgment, the two hands of nature herself, heat and cold.

Voorhout, a little village two miles from Leyden, had the honour of being the birthplace of Hermann Boerhaave, on the last day of the year 1668. His father, a minister of the Church of the Evangelist, was poor of means as he was pure of spirit. Hermann was the firstborn of his family, and with natural sentiment his father planned for him that he should enter the ministry, and for his early education in this direction acted himself as tutor. Hermann, as many incidental references in his life show, was, as a child, favourable to the calling; but while still in his twelfth year, he fell sick, and suffered on his left thigh from an ulcer, which was slow to heal. The pain from the open sore was extreme, and interrupted his studies, until he began, it is said on his own account, to treat the sore with a solution of salt and wine, essentially the old antiseptic "brandy-and-salt" treatment, which some half-century ago from this time was revived with much fervour. The treatment was successful, and under it the ulcer healed. From this effort to be a healer, the mind of the boy was turned to healing as an art or science.

Continuing his studies, after his recovery, still under his father's supervision, he reached, in 1682, his fourteenth year, when he went to the public school of Leyden, ran rapidly up to the sixth or highest form, and within eighteen months, including six months' probation, was admitted into the University of Leyden. The important event was marred by yet another, to him more important, the death of the good minister his father. There were, at this juncture, in the Boerhaave family circle our scholar, Hermann, one brother, James, seven sisters, and the widowed mother, all of whom had to be maintained on a provision very small indeed. Friends rose up. Professor Trigland, one of the Professors of Divinity, and no doubt a friend of the dead minister, took the young Hermann by the hand and brought him into contact with the Burgomaster of Leyden, Daniel van Alphen, and, under their advice and protection, he spent his academic life in the university, a many-gifted student, not singularly great in any one department of learning, but good in all, and industrious beyond common comparison. Thus, as one of his French admirers and biographers says of him, "Boerhaave

devint très versé dans l'hébreu, le chaldéen, l'histoire ancienne et moderne, même l'histoire ecclésiastique, et ce qui lui fut plus utile, la philosophie et les mathématiques."

In his nineteenth year our student made his first public appearance as a writer, or it may, perhaps, be more correctly said, as an orator. In 1689 he delivered, under the presidency of Jacob Gronovius, the famous professor of Greek, an oration on "Cicero and the Epicurean Philosophy," for which, as a probationary exercise, he received the gold medal of the university. This essay he does not himself include in the list of his published works; on the contrary, he excludes it by not naming it. It was probably, therefore, only privately published, although it long remained in the memories of those who heard it. It was an effort to prove that Cicero was well acquainted with, and confuted the doctrine of Epicurus on the chief good.

Up to this period of his life, Boerhaave, except for the boyish predilection for medicine already noticed, had continued in preparation for the ministry according to the wish of his father; while the younger brother, James, was intending to prepare systematically for a medical career. Of these facts there can be no doubt, because Boerhaave himself records them. In the preface to his great work on chemistry, published in 1734-5, towards the close of his life, Hermann, in dedicating the book to James, speaks of those early days of theirs, when both were students with destinies undetermined. "At that time," he reminds James, "your thoughts were turned chiefly to physic, mine to divinity. But Providence ordered otherwise, so that, altering your designs, you devoted yourself entirely to sacred things, making it your whole concern to promote the true worship of God by the plainness of your teaching and the integrity of your life; whilst I, conscious of my weaker abilities, and not daring to attempt anything higher, was content to apply myself to the study of the healing art."

How this change of career was brought about in this student, and afterwards master, of the art of healing, is a curious and interesting episode connected with his early life. His mind, as he has told us above, was set on divinity. To the study of theology he, therefore, devoted himself, in order to prepare for the usual examination and declaration required for the ministerial function. Being poor, however, he undertook to teach mathematics, in order to obtain the means to live and pay for his instruction. He succeeded as a teacher, and soon became famous as a scholar, writing, as such, a dissertation on the distinction of the mind from the body, which, though not acknowledged afterwards as a published work, attracted fame when it was first written. The public library of Leyden had bought from England some Vossian manuscripts, and it was necessary to compare these with the sale catalogue of them. Boerhaave was entrusted with this work, and did it so well that he became much admired in the university, and increased greatly the friendship of Vandenburg, a man of good discernment, who advised him to study physic as well as divinity. The advice taken, the great medical authors, Vesalius, Bartholinus, Fallopius, Hippocrates, Sydenham, Harvey, became his teachers. Next he turned to chemistry, and from that to botany, to which last-named science he lent himself, then and ever afterwards, with incessant zeal. He also studied anatomy from dissections under the direction of Professor Nuck, and in July 1693 he went to the University of Harderwick, and there took out a degree of doctor of physic, writing as his thesis on the practical subject of observing the excretions during periods of disease, "Disputatione de utilitate explorandum excrementorum in ægris ut signorum."

Still his intention was for the ministry, until there occurred the episode to which reference has, incidentally, been made.

At the time when this occurred, the theological world was wild on the doctrines of the learned and outspoken Jew, Benedict Spinoza, who in 1670 had published, in Amsterdam, his "Tractatus Theologico-Politicus," and who, dying in 1677, had left behind him three remarkable memories, a stoical practice of living, a resolute death, and a set of posthumous writings, afterwards published as the "Opera Posthuma," in which the heresy of the heretic was put forth with unconcealed freedom. Spinoza, in these days, would hardly be called a heretic. He would be considered in life and doctrine as a modern Stoic. He taught anew what had been taught of old, that God is everywhere. As Cato says:—

"Estne Dei sedes nisi terra, et pontus et aër
Et cœlum et virtus? Superos quid quærimus ultra?
Jupiter est quodcunque vides, quocunque moveris."

Where is the seat of God, unless it be
The earth, the air, the sea?
Where is the seat of God, unless it be
Virtue and Heaven? What further need we know?
Jove is whate'er we see, where'er we go.

But Spinoza, in his day, was heretic to Catholic and Protestant alike; and he who breathed his name admiringly, or even apologetically, was branded Spinozist, a bad name which our Boerhaave, in the following manner, got accredited with.

In a passage boat, or packet, in which Boerhaave was sailing, the passengers were discussing Spinoza. One more loudly than the rest condemned the great Jew in no measured terms, whereupon Boerhaave put in the pointed question, whether the declaimer had ever read the works he so outrageously criticised? "The orator," it is said, "was at once struck dumb and fired with silent resentment." Then some other passenger, having learned Boerhaave's name, wrote it in a book, and when the would-be minister of religion arrived at Leyden, he found himself a Spinozist. He had now two goals before him, the pulpit or the medical professor's chair. If he tried for the pulpit, such was the clamour against him, that he, son of the honoured orthodox divine, might be refused the licence. That goal was, therefore, clouded; the other was clear before him. The choice was as sound for his own future fame as it was beneficial for the great world of thought, which it was, henceforth, his duty and pleasure to serve and illuminate. The choice was medicine.

The goal determined on, Boerhaave moved steadily along his selected way. He accepted the office of lecturer on the Institutes of Medicine, with Professor Drelincourt as his titular superior, a splendid chair in which medicine as a practice was based on medicine as a science, physiology with practice hemmed to it. In 1701 he opened his course with an oration on the works of Hippocrates. It was an eloquent vindication of that natural method of study which the Father of Physic so splendidly set forth, and which the iatro-mathematicians, or mechanical theorists, had just previously so widely departed from and ignored. The oration was delivered on the 18th of May, 1701, and was the foundation of Boerhaave's future celebrity as a professor, practitioner, and natural philosopher. In that effort he foreshadowed the greatness of the name of Boerhaave in Europe.

Fortunately, the happy reception he had met with in his first attempts tied him to his native city for his life's work. In 1703 he was tempted to accept a professor's chair in the University of Gröningen. He declined, and remained faithful to Leyden, adding practice to professional teaching. The result, in respect to practice, was good, for Leyden was then a centre of great wealth, and the patients of Boerhaave rewarded him for his services with no mean hands. To him the rich flocked and paid their fees as freely as their admirations. "Princes, kings, nay emperors themselves," says one of his biographers, came to consult him; and one wealthy Englishman presented him with a beautiful and commodious country house in return for some simple, but efficacious, piece of advice on the art of rowing a boat in such a manner as to combine healthy exercise with an oarsman's skill.

From his starting-point onwards and onwards, through the history of thirty-seven years, our Boerhaave continued his course with honours and duties increasing upon him, yet not without some alloys, which to many men had been fatal. He became great as a teacher, with students from all parts of the world crowding his lecture room. He became so great as a writer that one at least of his works was translated into an Oriental tongue, and circulated, with idiomatic expositions, through the Ottoman empire. He became great as a botanist, and so enriched the physic garden of his university with new plants that it had to be enlarged to double its original size. He became great as a chemist, and, indeed, so great that his influence on organic chemistry remains unto the present hour. He became famous as an orator, treating fearlessly on metaphysical and crucial subtleties, on which the mind of man is ever violently tossed and vehemently shaken. And, if he did not become great, he became famous as a physician, which is perhaps as much as can be said of any man on that side, seeing that favour in practical physic fluctuates with the tastes of the time in which it flourishes, and in like manner vanishes.

To all these distinctions he added goodness, sweetness of soul, simplicity of life in the lap of luxury, gentleness in the storm of persecution, versatility in the midst of industry, poetic sentiment less poetic rhythm. His light was as that of the lamp before the altar, always burning, never flaming high; a guiding light steady as that of a polar star.

The portrait of Boerhaave in this ASCLEPIAD, autotyped from G. White's engraving in the British Museum, gives us the man just at his prime. He looks like our Oliver Goldsmith more than any other man of history I can at this moment remember. A broad Saxon face, with features large and fine, except the nose, which, with Teutonic obstinacy, will turn upwards, to the decided injury of the beauty of the profile, when another portrait showing that is looked at. The head is massive, the forehead broad and prominent, the eye full, the ear with a big lobe, the lips well developed, and the cheek bones rounded and expansive, but flattened. The expression is not commanding, but good-tempered, determined close up to obstinacy, and wanting altogether both in Semitic subtlety and Keltic fire. In fine, the face of a pure

Saxon, coming up as near to genius as any pure Saxon can come by the forces of intense study, varied application, and incessant indomitable industry.

That a man so constituted would say and write many things that went against the prejudices of others, without himself foreseeing the effect, were a moral certainty and a natural fate. But whatever harm might spring from this course was compensated for by the trust he had in his own industry, and by the entire absence of resentment which held him placid and unmoved through all those wild controversies which, like storms and hurricanes, never destined to last long, so often waste their fury harmlessly if they are not counterblasted, and when they have cleared the air, leave those they have attacked in greater force than ever.

How calmly Boerhaave accepted the severest trials of calumny was well instanced in 1715, the year of his zenith in living fame. He was at that period forty-seven years of age. He had succeeded to the full professorship of medicine over five years, having been elected professor in 1709; and now, in 1714-15, he had received the highest honour his university could bestow by being elected rector of the university. The election necessitated the delivery of a rectorial address, which was published in 1715. The oration was a defence of the line of research in science by experiment. It expressed boldly that man has nothing to do with the question of origins of things, but has all to do with the question of the working of things which have arisen. Thus he was led to attack, without offence but with striking power, the philosophy of Descartes and of the Cartesian school. Thereupon M. Andala, a professor of divinity and philosophy at Franeker, and an ardent Cartesian, opened fire upon the Leyden professor with a fury that deafened even himself. The Church was declared to be in danger, scepticism rampant, Spinoza dominant. Through the storm Boerhaave sailed most serenely of all men, friends or foes. The colleagues of Andala insisted that he should retract the aspersions and innuendoes which he had so freely put forth, and succeeded in getting him to recant, with further promises of reconciliatory expressions. The retractation, sent by its author to the slandered Boerhaave, called from him the simple and gracious reply, that the pleasure of the reception was enhanced by the knowledge that the learned professor of divinity would have no more trouble on his account. A man so happily constituted, "born of a happy disposition," as Joseph Priestley was wont to say, could live through anything.

To these natural qualities of mind Boerhaave added habits which were alike conservative against failure. He was frugal, and, therefore, wealthy; industrious, and, therefore, learned; versatile, and, therefore, happy; privately liberal, and, therefore, careless about the false charges of parsimony raised against him. To him the outside world was of little moment; his garden, his study, his laboratory were the three worlds in which he lived, moved, and had his being; nor is it possible to find any other worlds in this life more delightful. I, at all events, know of none, and specially envy him his garden, which of the three worlds is the one I have all my life most longed for, and never possessed.

To these three resorts of mind Boerhaave added some resource derived from music. This could not, I think, have been very high, seeing that his selected instrument for personal performance in the musical line stopped at the flute.

We know Hermann Boerhaave now from the pencil of the artist. We have some fair idea of him from the pens of the biographers. We can, in truth, visit him in his old city of wealth and learning and industry and commerce. We can depict him coming in, in the morning, from that country seat which the rich Englishman gave to him for a lesson in rowing. We can follow him in his round of visits on the sick; go with him to the university to meet his troops of disciples; see him put on his professional robe, and with the dignity of office common to those days, take the professor's chair; hear him lecture on the Institutes of Medicine, or attend his clinique, or listen to him while expounding the principles of organic chemistry or the nature and classes of plants. We can move with him from the lecture room to the laboratory, furnished with its, to us, quaint apparatus, by the use of which such as he literally struggled into knowledge, inventing apparatus as they went on. We can sit down with him in his town mansion to the richly served but frugal midday meal, in such a room as Jan Steen loved to paint; we can go back with him to the country house, walk with him round his garden, enjoy his descriptions of the latest tropical productions with which he has become enriched; enter with him to his simple supper with wife and children, and may be Brother James the minister, whose whole concern is "to promote the true worship of God by the plainness of his preaching and the integrity of his life;" be treated, haply, to an exercise on the flute from the great professor himself; and finally, directed by his gentle hospitality to repose, hear his good-night, and sink into sleep to dream of him as in this dream.

From the date of his rectorship of the University of Leyden, 1714, Boerhaave lived on until 1738, with apparently but two important changes in his career. In 1715 he was elected to fill the chair of practical or clinical medicine, rendered vacant by the death of Professor Bidloo, whose duties he had long supplemented; and in 1718, on the death of Professor Le Mort, he was also elected to the chair of chemistry. This last election is worthy of special note, because it led, ultimately, to the preparation and publication of the great Boerhavian treatise on the "Elements of Chemistry," to which particular reference will soon have to be made. Through all this time he maintained good health and good spirits, for he was a man of exercise as well as thought. With his students in the country, in botanical excursions, or in quest of other fields of natural science, he drew in the breath of healthy life, and literally re-created.

All the while, too, honours came dropping in to cheer him on his way. The Academy of Sciences of France, the Royal Society of England, enrolled him amongst their illustrious, and were proud of his name.

THE WORKS OF BOERHAAVE.

"Everything else printed in my name, except a few prefaces, is spurious, and published without my knowledge," are the words written by Boerhaave in the preface to his last work, dated Leyden, July 1st, 1731. Then follows a list of fifteen works, ranged in order of time, with a brief explanation of the more important of them, and with some strange omissions, including that of the edition of Vesalius which was published in his name in conjunction with that of Albinus.

Let us devote a page or two to the study of the choicest of these accepted and always acceptable works. The first of them, the oration on Hippocrates, commending the labour of the Father of Medicine to the study of all his sons, was entitled :—

"*Oratio de commendando Studio Hyppocratico. Spoken and printed at Leyden*, 1701. *For Abrah Elsevier.*"

The next essay was an attempt to bring about a reconciliation between the vitalists and the mechanical philosophers in physic. The mechanical theorists, influenced by the works of Alexander Pitcairn, a Scotchman, who, during the year 1691-92, had held the chair of physic at Leyden, and who played a notable part in his day,—a part which I hope to review in these pages,—were usurping the place of the vital theorists. Boerhaave, too judicious and careful to be led away by either school, adopted, in the essay now under notice, what may be called a compromising criticism, by endeavouring to establish unity between the two contending sections. The effort, which from the very nature of it is not the strongest of his efforts, was entitled :—

"*Oratio de Usu Ratiocinii Mechanici in Medicina*, 1703. *For John Verbessel.*"

From 1701 up to 1708 Boerhaave continued to act as lecturer on medicine, and during this time composed and published the first edition of his great work, the "Institutions of Medicine." This work, intended in the first instance for his disciples, expanded as it went on, in edition upon edition, until it became the medical text-book of Europe. It was divided into five parts, with a preliminary historical outline. The five books were respectively devoted to physiology; pathology, including etiology and morbid changes; semiology, under which are discussed the indications of health and disease; hygiene, divided into prophylaxis and regimen; and therapeutics. The Institutions or Institutes were richest in value in those parts which exhibited the erudition of their author. The last chapter on therapeutics was poor, and, as many have conceived, wanting altogether of faith in remedies. The hygiene is advanced; but the cream of the work was the historical introduction. This has ever been a subject of admiration, and to English medical scholars is doubly precious from its noble defence of William Harvey as the discoverer of the circulation of the blood. "Immortalis Harveius demonstrationibus suis omni priorum theoriâ eversa, novam omnino, et certam, jecit huic basin scientiæ." To Sydenham he pays reverence little inferior,—"The immortal Sydenham." The Institutions are described by Boerhaave, in 1731, under the title:—

"*Institutiones Medicæ in Usus annuæ Exercitationis Domesticæ*, 708. *For John Vander Linden, Father and Son, and afterwards reprinted several times, with Additions in* 8*vo*."

The Institutions were followed in the next year by a volume of Aphorisms. These related to matters of a medical kind, eminently practical and terse. They embraced collections of observations derived from the ancient as well as the then current learning, and were afterwards quoted on all hands by the admiring pupils of the master. Boerhaave announces them in his final work as:—

"*Aphorismi de Cognoscendis et Curandis Morbis in usum Doctrinæ Domesticæ*, 1709. *For John Vander Linden, of which there were afterwards several editions with additions.*"

In the year when the Aphorisms appeared, the lecturer, Boerhaave, was raised to the rank of professor of medicine and botany in the place of Professor Drelincourt, whose duties he had so long carried out in fact, though not in rank. The promotion gave origin to another inaugural address or oration, the theme the restoration of medicine to its primitive simplicity. The essay is marked by its author as :—

" *Oratio quâ repurgatæ Medicinæ facilis asseritur Simplicitas*, 1709. *For John Vander Linden.*"

In the following year, 1710, he issued :—

" *Index Plantarum, quæ in Horto Academico Lugduno-Batavo reperiuntur*, 1710. *For Cornelius Boutestein, in 8vo.*"

I have already related that in 1714-15, upon his elevation to the rectorship of his university, Boerhaave delivered an oration which was hotly received in some quarters. I insert here in due form, from his own words, the title of the work :—

" *Oratio de comparando certo in Physicis*, 1715. *For Peter Vander Aa.*"

On election to the chair of chemistry, in 1718, he delivered and issued a new inaugural address :

" *Oratio de Chemia suos errores expurgante*, 1718. *For Peter Vander Aa.*"

In the next year he gave forth :—

" *Materia Medica et Remediorum formulæ*, 1719. *For Isaac Severinus.*"

Two years later the masterly treatise on Albinus the anatomist saw the light, as :—

" *Oratio de Vita, et Obitu Clarissimi Bernardi Albini*, 1721. *For Peter Vander Aa.*"

Some minor works, including *A Medicinal Treatise,* "*De Lue Venerea,*" *prefixed to the Collection of Authors upon the Venereal Diseases*, 1728. *For John Arn Langera and*

John and Hermann Verbeck, in folio," were succeeded by two final literary and scientific labours, which have yet to be noticed, and which themselves, alone, would have left their author safe in history.

In 1730 he was for a second time elected rector of the university, and in 1731 he resigned the chair of botany and chemistry, upon which he delivered the first of these final works and his last public discourse. As he commenced his professional utterances, so he ended them. His last oration was one of homage to the simple Hippocratic school of medicine. It is summed up by him under the description :—

"*Oratio de Honore Medici Servitute*, 1731. *For Isaac Severinus. An Oration which he delivered when the Curators of the University honourably gave him leave to resign his Professorships of Botany and Chemistry, in* 1729."

In the year 1731 there appeared the final and great work, "*Elementa Chemiæ quæ anniversario labore docuit in publicis privatisque scholis.*" This is the work, Magnum Opus, dedicated to the brother James, with surprise at the number of the labours and "the remarkable dangers which frequently attended them, and in which the brother was the faithful companion and partner."

A review of this volume alone would, without a word in excess, call for another such an article as the present, to which I must not now be tempted. The book is a massive quarto, divided into two parts, the "Elements" and the "Practical Part." It is hard to say which is the best. The first part, rich in history and rich in practice, is full of the most curious details. It gives, in the elementary division, a drawing of the first thermometers constructed by Fahrenheit, and of one for taking the temperatures of the human body. It describes alcohol, air, dew, fire, heat, ice, petroleum, phosphorus, water, in a way as novel for its period as valuable for its simple suggestive advancements. In the second part there is laid the whole basis of modern organic chemistry. In this part, as Dr. Thudichum, with his usual learned acumen, has pointed out, we get our first acquaintance with the substance since called urea, crystallized out "in saline globes of a particular kind that are perfectly distinct from every other salt, not fœtid, not alkaline, but very evanescent, the native salt of urine."

As I turn over the leaves of the "Practical Chemistry," I drop by accident, at page 130, on the modern observation that compressed air prevents fermentative action, that borax is recognised as an antiseptic, and an immense number of other facts equally useful and instructive.

THE LAST DAYS OF BOERHAAVE.

After resigning his chairs of botany and chemistry in 1729, Boerhaave began to retire more determinately to his country house, and to live apart from the world. He had suffered in 1722 from arthritic pains, probably of a gouty nature, so severely that he was confined to his bed for six months. Five years later he was again laid by, and two years later still he was obliged, from repetition of illness, to give up the active duties of life. But in his country garden he found abundant pleasures. On eight acres of garden ground he cultivated every plant he could obtain and that could be cultivated. He esteemed a present of some American plants as gifts better than gold, "*munera auro cariora*," and two cedars as "*regali beate dono.*" But gradually his powers declined, although he attended to some private business. In 1737 he suffered from breathlessness, and in a letter which he wrote to Baron Bassand, and which is copied by Dr. Burton, to whose life of the master I am deeply indebted, he tells the story of his own impending fate. "He has an imposthumation of the lungs, which almost suffocates him on the least motion, under which, if it should continue without bursting, he must sink, and under which he may sink if it should burst; but happen what might, he was not concerned, since what could he desire that was different from the will of the Supreme Being? He was not wanting in the use of the most approved remedies, but no way anxious as to the success of them. He had lived to sixty-eight years, and always cheerful." He survived still a year, diagnosing his own case, and coming to the conclusion, from the irregular action of the heart and the unusual pulsation of the carotids on the right side, that there was dilatation of the large vessels from the heart, with polypus concretions on the right side of the heart extending towards the lungs. To the famous secretary of the Royal Society of London, Dr. Mortimer, he wrote, detailing his symptoms, on September the 8th, 1738. On September the 23rd he finally sank into the rest he did not fear.

On the tomb of Hermann Boerhaave, his beloved in life copied his beloved motto, *Simplex sigillum veri*, to which they added, *Salutifero Boerhaavii genio sacrum*, two sentences which beyond any words of any historian declare and immortalize his honoured name.

OPUSCULA PRACTICA:

USEFUL NOTES FOR BUSY PRACTITIONERS.

> "There are mites in science as well as in charity."
>
> Benjamin Rush.

LOCAL TEMPERATURES ON INFLAMED SURFACES.

I HAVE often been tempted to ascertain whether on inflamed surfaces there is an elevation of temperature above the feverish temperature of the body generally. In order, however, to arrive at the truth on this point, it was important to have the opportunity of taking observations on some case, from hour to hour, for several hours; and that opportunity did not occur. But on Thursday, May 28th, being in expectation of a summons to a consultation in a case of small-pox, I got my friend Dr. Jackson, during a visit here, to re-vaccinate me, and, to my surprise, my arm "took" in two places just as in a primary vaccination. The vesicles yielded a free amount of lymph; there was extreme redness and heat of surface extending three inches around the vesicles; there was some sympathetic pain in the axilla, and rather sharp general symptoms for three days.

The inflamed part feeling very hot and painful, and conveying the idea of increased local temperature when I touched it with the hand or with the lip, I made a series of careful determinations of the temperature of the inflamed surface and of the general temperature. The results may be briefly stated as follows. On the seventh and eighth days after the re-vaccination, when the general and local disturbances were most marked, the local temperature rose to 102° F., and for six hours on the eighth day to 103°. During this time the general temperature in the mouth and in the axilla rose, when pyrexia was marked, to the same degrees. On six occasions the local and general temperatures remained the same for three hours at a time. Under free action of the skin the general temperature fell steadily, from 103° to 100°; then from 102° to 99°; but during these periods the local temperature was maintained at the highest figure. On the ninth day both temperatures, general and local, had gone down to 100°, but in that day there was for eight hours a remission of the general increase with a continuance of the local. So soon as the general temperature returned permanently to the natural, which it did on the eleventh day, the local temperature either followed, or attended, in declension, and resumed the natural degree before the redness ceased, but not until the pain had passed away.

This single observation must not, of course, be taken for more worth than as an indication of a study which deserves to be closely followed up. What it seems to teach is that, in local inflammations, the temperature at the affected part does not rise above the fever temperature of the body when the fever is on, but that it is sustained when the fever is off,—a very important distinction in respect to the local changes which take place under the inflammatory process. It suggests also that the cause of elevation of local heat is of local origin, and it gives us a hint as to the importance of reducing high local temperatures by local means.

There was one other point which I tried to determine, namely, whether the local burning pain was increased or decreased by the general or systemic fever. It seemed to me very certain that, when the general temperature was reduced, the sense of local pain as well as of local heat was most distinct. The tingling then was greater, and the feeling of weight and throbbing was intensified. As fever came on, these local signs lapsed into the general, as if, during the febrile paroxysm, all the system were in a state of diffused heat and pain, which, for the time, masked the local subjective manifestations.

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USE OF LEITER'S TUBES FOR REDUCING LOCAL TEMPERATURES.

THE note offered above leads me to refer to the great value of Leiter's tubes for reducing local temperatures. Long ago I invented an elastic bag to fit the neck, through which bag cold water could be made to flow in steady stream, so as to cool the venous blood passing through the jugulars to the heart, and to exert a sedative influence over the sympathetic cervical ganglia. This plan, first tried in the Samaritan Free Hospital, in a case under the care of Sir Spencer Wells, was superseded by the tubular rubber cap, suggested by Mr. J. Knowsley Thornton. Leiter's tubes carry out the same principles with an improved mechanical arrangement. The cold water runs through metallic tubes made either of light lead or of aluminium, and so planned that they can be adapted to the head, breast, abdomen, or other part, with great facility, the water passing through them, by syphon action, with freedom and regularity. In a case of peritonitis in an adult lady, attended with extreme pain and high general temperature, 104° Fah., I have used the tubes during the past quarter with singular benefit. By placing the series of circular tubes over the abdomen and continuing the current of water at 50° Fah. for two hours, the temperature of the surface of the body beneath the tubes was brought down to 90°, a result followed by relief of pain, a fall of the systemic temperature to 101°, and a general relief of symptoms which was in every sense satisfactory. On removing the cold rather too hastily, there was some reaction, with return of pain and increase of fever, which was again met by repeating the application of the tubes and continuing it with little intermission for three days, at the end of which time the natural temperature had been obtained, and recovery fairly advanced. I recollect few remedial efforts in which cause and effect seemed more clearly to stand out than in this instance.

SUGGESTION FOR A DRY COLD BATH HAMMOCK IN CASES OF FEVER.

THE use of the Leiter tubes has led me to suggest to Messrs. Krohne and Sesemann that they should construct a dry cold bath by placing on elastic bands a range of tubes, for conveying water in current so as to make up a swing cot or hammock for cases of fever. In such a hammock a patient could be laid without any of the inconveniences of the common water bath, and could be subjected over all the body to any degree of cold which the physician or surgeon might desire. I think that in a hammock so constructed the temperature of the body could be prevented from rising beyond the natural after surgical operations, and that in states of fever the cooling could be brought down, and kept down, with as much readiness as an engineer can moderate motion from heat by lowering his lamp or fire. For the treatment of the acute febrile diseases of children a small hammock of this kind would be made to form, for a time, the bottom of the ordinary cot, and would create no alarm. The tubes, on springs, would adapt themselves to the movements of the body, and, covered by a soft, thin, and very porous mattress, would be perfectly comfortable to rest upon.

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AN IMPROVEMENT IN THE TREATMENT OF NÆVUS BY SODIUM ETHYLATE.

IN the treatment of nævus by sodium ethylate much time may be lost in waiting for the removal of the crust which is formed after the ethylate has been applied. While waiting for the loosening of the crust it often happens that the nævus undergoes fresh growth beneath, exhibiting a very red and irritable surface after the crust is removed for reapplication of the ethylate. In order to prevent these difficulties I have modified the plan of operation in a way which, in two cases, has proved most successful. The modification is as follows:—

Over the nævus, at the first application I apply the ethylate very freely, adding a second layer of it when all the watery oozing has ceased. This causes in three days an extremely firm crust. On the third day, while the crust is still firm, instead of removing it, I puncture through it in three or more places with a sharply edged small flat needle, and with the needle I break up the vascular surface beneath freely. On withdrawing the needle a few drops of blood exude from the needle points, which blood I take up with cotton wool, pressing firmly so as to empty the surface entirely of blood. Then I apply over the whole surface a little ethylate, and do no more for four days. At the end of that time if, on pressing the crust, there is evidence still of fluid underneath it, I once more insert the needle and treat as before, but if the scale be flat and firm, I let it remain until it falls off of itself and leaves an even and healthy surface.

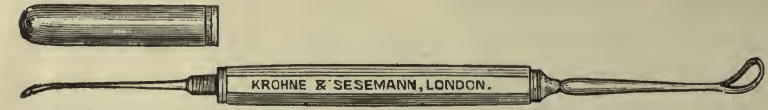


FIG. 1.

In the diagram inserted above there is figured the kind of needle used. The needle is fixed in a light bone handle, at the other end of which there is a steel loop or scoop for loosening and removing the crust if that operation be required.

STYPTIC OR HÆMOSTATIC ETHER.

IN first observing the influence of the cold produced by the dispersion of absolute ether during operations, nothing struck me more than the effect of the cold in immediately stopping the flow of blood. For a time, cold alone, when carried to a sufficient degree, prevents all venous and capillary hæmorrhage, and even the hæmorrhage from small arterial trunks. After a time, however, as reaction returns, and the vessels relax under the influence of heat derived from the renewed circulation, there is bleeding, which, if a wound be closed too quickly, is a cause of after-trouble. The observation of the immediate effects of cold led me to think that if they could be supplemented by a styptic which would spray evenly with ether, and which would take up the constringing action when the vessels commenced to relax, an important desideratum in practice would be supplied.

With this object in view, I requested Mr. Robbins to make for me a solution consisting of absolute ether, having a boiling point of 95° Fah., charged to saturation at a low temperature with tannin, and afterwards treated with collodion, a little short of saturation. The compound came out well. It ran easily through the spray tube without blocking; it produced good local anæsthesia, and it possessed an agreeable odour.

In order to test to the extreme the effects of this preparation as a styptic, I took sheep's blood, removed, by whipping, all the fibrin, previous to coagulation, and then let the blood remain exposed to the air for two days to ensure partial decomposition. In this way the blood was rendered nearly as fluid as port wine, and in the most unfavourable condition for being transformed into clot. A few drachms of this blood were now placed in a saucer, the saucer having been warmed to the temperature of the body. The spray of the styptic ether was then directed upon the blood from a full-sized spray tube, and in five seconds the whole mass of blood was so thoroughly solidified that the saucer could be turned upside down without any escape of fluid. The blood, which had previously presented the odour of putrefaction, was also deodorised, and remained inodorous for ten days. It had a firm, leathery consistence, and on its upper surface a fine whitish layer, with a bright vermilion colour beneath.

These are the effects of the styptic ether on blood the spontaneous coagulability of which has been lost; but they are trifling when compared with what takes place on blood newly drawn, and containing fibrin. In this case coagulation under the spray is the work of a second.

When styptic spray is directed on an open bleeding living surface, the primary effects are those produced by the cold—namely, the condensation and whitening of the tissues. If blood be flowing, it solidifies, and when the parts relax, new blood that may ooze up enters the solid blood as though it were a sponge, the coagulation soon stopping further flow.

The elements of this process are three in number:—

1. The immediate constringent effects of cold on the blood-vessels.

2. The styptic action of the solution on the fibrin and albumen of the blood.

3. The extreme mechanical fineness of distribution of the fluid on the bleeding surface.

Styptic ether can also be applied to the hæmorrhagic surface after the extraction of a tooth, for hæmorrhage from cancerous disease of the uterus or other cause; and in cases of hæmorrhage from piles.

I introduced styptic spray through the *Medical Times and Gazette* of April 26th, 1866, have had it in regular service ever since, and have not once known it to fail in the uses first claimed for it.

A SYNOPSIS OF ANÆSTHETICS.

UNDER the impression that it may prove of some service, for reference, to the learned scholars who are about to discuss the subject of Anæsthesia at the forthcoming meeting of the British Medical Association at Cardiff, I have constructed, in the following essay, a synoptical view of all the important general anæsthetics that have been discovered from the revival of the practice of Anæsthesia in 1846. It is thirty-nine years this year since I first took part in the administration of anæsthetic agents, and as every one of those to be named in the synopsis has passed through my hands for administration, either to man or to one of the lower animals, I write upon them with an advantage which is to a large extent exceptional, and which is, I trust, a sufficient apology for the present offering.

In the Synopsis the following points are kept in view.

1. For the sake of ready reference the anæsthetics are placed in alphabetical order, both in series and in detail.

2. Each series starts from what is called the anæ-

sthetic base. This means, for reasons I have assigned in another essay, that every anæsthetic derives its narcotic power from a certain definite chemical element, or chemical combination of elements, which plays its part independently of all other elements that may be combined with it.

3. The physical properties of each anæsthetic are briefly stated, including the chemical construction; the specific gravity in the case of fluids; the boiling points Cent. and Fahr.; the vapour density; and the solubility in the blood when that is fairly known. The reader will please remember under this head that water as 1,000 is taken as the standard for Specific Gravity (Sp. Gr.); and Hydrogen = 1 as the standard for Vapour Density.

4. An epitome is offered of the more important comparisons in relation to the physiological action of the substances specified.

5. The anæsthetic value of each substance is estimated, as far as I have been able to appraise it, from direct observation of its action.

6. The date of introduction and the name of the first experimentalist of each anæsthetic is supplied in order of priority of original research.

7. The modern chemical nomenclature of all the substances is supplied. This has changed so much since the date of the commencement of anæsthetic research, that it becomes a difficulty to present the substances, as they were known under their old names, in the new names assigned to them, without creating some confusion. I have done my best, however, to put the anæsthetics as nearly as possible into their most modern denominations, and in such manner as to make the transitions easy as well as intelligible.

I.—Amyl Series. Anæsthetic Base, Amyl (C_5H_{11}). A gas. Vapour Density, 35·6. H. = 1.

Amylene (C_5H_{10}).

Physical properties.—A colourless fluid, Sp. Gr. 0·659 at 60° F. Vapour Density, 35. Boiling-point, 35° C., 95° F. Solubility in blood, 1 in 9000. Vapour burns in air.

Physiological properties.—Odour of vapour, like wood spirit, not pungent. Quantity of fluid required for complete anæsthesia, 4 to 8 fluid drachms. Required charge of air by vapour 15 per cent. Anæsthesia rapidly produced, with short but sharp second or spasmodic stage. Consciousness sometimes apparently retained during insensibility, as in somnambulism. Recovery rapid, with freedom generally from all after-effect. Vomiting extremely rare.

Anæsthetic value.—Doubtful. Caused two deaths in 238 administrations between November 1856 and July 1857. Sudden failure of cardiac motion is the source of danger from amylene.

Date of introduction, 1856.—John Snow, M.D.

Amyl Chloride ($C_5H_{11}Cl$).

Physical properties.—A colourless fluid, Sp. Gr. 0·886. Vapour Density, 53·25. Boiling-point, 102° C., 215·6° F. Vapour burns in air.

Physiological properties.—Odour of vapour slightly pungent. Quantity of fluid required for complete anæsthesia, 6 to 8 fluid drachms. Required charge of air 10 per cent. Action slow, with very slight rigidity in second stage. Anæsthesia extremely profound and prolonged. Animal temperature much reduced. Recovery rapid when it commences. Vomiting frequent. The great peculiarity in the action of amyl chloride is in the reduction of animal temperature. In one instance, in the rabbit, temperature fell from 103° F. to 82° F., 21 degrees, yet perfect recovery, in warm air, followed.

Anæsthetic value.—Anæsthesia too slow and profound for ordinary practice, but might be valuable for reduction of high febrile temperatures. After death cardiac action is long persistent. Blood fluid, but of natural colour on both sides. Red corpuscles shrunken and elongated, with truncated ends, some stellate. The brain left bloodless, and of purest white.

Date of introduction, 1869.—B. W. Richardson, M.D.

Amyl Hydride ($C_5H_{11}H$).

Physical properties.—A colourless fluid, Sp. Gr. 0·625. Vapour Density, 36. Boiling-point, 30° C., 86° F. Solubility in blood undetermined, but not greater than 1 in 15,000 parts. Vapour burns in air.

Physiological properties.—Vapour odourless, and free of pungency. Quantity of fluid required for complete anæsthesia, 6 to 12 fluid drachms. Required charge of air by vapour 40 per cent. Anæsthesia very rapid, profound in two minutes, with short period of spasmodic movements. Recovery very rapid, without vomiting. The temperature of the body unchanged.

Anæsthetic value.—Action extremely rapid, but dangerous, probably from insolubility of vapour in blood. Heart easily paralysed, but irritability of voluntary muscles long retained.

Date of introduction, 1867.—J. Bigelow, M.D.; B. W. Richardson, M.D. (1867).

II.—Butyl Series. Anæsthetic Base, Butyl (C_4H_9). A gas. Vapour Density, 28·5.

Butyl Chloride (C_4H_9Cl).

Physical properties.—A colourless fluid, Sp. Gr. 0·810. Vapour Density, 46·25. Boiling-point, 70° C., 158° F. Solubility in blood undetermined. Vapour burns in air.

Physiological properties.—Practically identical with those of amyl chloride.

Anæsthetic value.—Practically the same as for amyl chloride.

Date of introduction, 1869.—B. W. Richardson, M.D.

Butyl Hydride (C_4H_9H).

Physical properties.—A permanent gas at ordinary temperatures. Vapour Density, 29. Burns in air.

Physiological properties.—Same as for amyl hydride, but action more rapidly developed.

Anæsthetic value.—Same as for amyl hydride, but, being a gas, less practical for administration.

Date of introduction, 1867.—B. W. Richardson, M.D.

III.—Benzine Series. Anæsthetic Base, Benzine ($C_6'H_6$). Fluid. Vapour Density, 39.

Benzine or Benzole ($C_6'H_6$).

Physical properties.—A colourless fluid, Sp. Gr. 0·885. Vapour Density, 39. Boiling-point, 82° C., 179·6° F. Solubility in blood undetermined. Vapour burns in air.

Physiological properties.—Vapour heavy, and disagreeable to breathe. Action determinate, but slow.

Anæsthetic value.—Very indifferent, and after-effects severe and prolonged.

Date of introduction, 1848.—J. Snow, M.D., and Sir J. Simpson, M.D. T. Nunneley (1849).

IV.—Carbon Series. Anæsthetic Base, Carbon (C). A solid. Combining weight 12.

Carbon Bisulphide (CS_2).

Physical properties.—A colourless fluid, Sp. Gr. 1·272. Vapour Density, 38. Boiling-point, 43° C., 109·4° F. Solubility in blood undetermined. Vapour burns in air.

Physiological properties.—When perfectly pure, of pleasant ethereal odour and free of pungency. Quantity for complete anæsthesia, 4 to 8 fluid drachms. Required quantity of vapour in air 10 per cent. Anæsthesia very rapid, produced in from three to five minutes, with brief spasmodic stage. Recovery rapid and complete, with few bad effects. Reduction of animal temperature under deep anæsthesia, 2° F.

Anæsthetic value.—Not as yet determined. From experiments on inferior animals it seems to be very safe. Death in the vapour is gradual, the circulation outliving the respiration. In one animal, a dog, author observed life return, spontaneously, after respiration had ceased for seven minutes.

Date of introduction, 1849.—T. Nunneley. Harold Thanlow, M.D. (1850). B. W. Richardson, M.D. (1868).

Carbon Dioxide (CO_2).

Physical properties.—A colourless gas. Vapour Density, 22. Extinguishes flame.

Physiological properties.—Inodorous, slightly pungent to breathe; air containing 25 per cent. of gas produces rapid insensibility. Insensibility deep, with convulsive action, asphyxia, and reduction of temperature.

Anæsthetic value.—Not as yet fully investigated. Death apparently from asphyxia, with respiration failing primarily and the muscular irritability becoming rapidly exhausted. After-effects of recovery from deep anæsthesia are neither very prolonged, nor severe.

Date of introduction, 1848.—J. Snow, M.D. T. Nunneley (1849). B. W. Richardson, M.D. (1852).

Carbonic Oxide (CO).

Physical properties.—A gas. Vapour Density, 14. Vapour burns in air.

Physiological properties.—Almost inodorous, and breathed without irritation. 5 per cent. in air causes rapid anæsthesia, with convulsive action, and fall of temperature 2° F. under deep narcotism.

Anæsthetic value.—Too dangerous for general use as an anæsthetic, although on lower animals it has been used for operations many times by the author. After death both venous and arterial blood of a bright red colour.

Date of introduction, 1849.—T. Nunneley. J. Snow, M.D. (1852). Thornton Herapath (1852). B. W. Richardson, M.D. (1852).

Carbon Tetrachloride (CCl_4).

Physical properties.—A colourless fluid, Sp. Gr. 1·560. Vapour Density, 77. Boiling-point, 77° C., 170·6° F. Solubility in blood undetermined. Vapour extinguishes flame.

Physiological properties.—Vapour rather pleasant, with little pungency. Quantity for complete anæsthesia, 4 to 8 fluid drachms. Required charge of air by vapour 5 to 10 per cent. Anæsthesia very slow and prolonged when induced. Convulsive stage long and acute.

Anæsthetic value.—Indifferent. Action too slow, recovery too prolonged. Temperature reduced during deep anæsthesia, 4° F.

Date of introduction, 1867.—Arthur Sansom, M.D., Protheroe Smith, M.D. (1867).

V.—Ethyl and Ethene Series. Anæsthetic Bases, Ethyl (C_2H_5). Vapour Density, 15. Ethene (C_2H_4). Vapour Density, 14.

Ethyl Bromide (C_2H_5Br).

Physical properties.—A colourless fluid, Sp. Gr. 1·473. Vapour Density, 54·5. Boiling-point, 41° C., 105·8° F. Solubility in blood undetermined. Vapour burns with green flame.

Physiological properties.—Vapour ethereal, slightly pungent, rather irritating to inhale. Quantity required for complete anæsthesia, 1 to 6 fluid drachms. Required charge of air by vapour from 5 to 10 per cent. Action rapid and effective, with scarcely any second or spasmodic stage. Recovery from deep narcotism, in from four to five minutes, without bad effects. During full anæsthesia animal temperature reduced 2° F.

Anæsthetic value.—Was considered by Nunneley to be one of the best of anæsthetics, in which view I concur. Objections to its use are its cost and instability as a compound. No death from it has occurred in the human subject. In death induced by it in lower animals, the respiration and circulation fail together.

Date of introduction, 1849.—T. Nunneley. M. Robin (1850). B. W. Richardson, M.D. (1870).

Ethyl Chloride (C_2H_5Cl).

Physical properties.—A very volatile fluid, Sp. Gr. 0·921. Vapour Density, 32·25. Boiling-point, 11° C., 51·8° F. Solubility in blood undetermined. Vapour burns in air.

Physiological properties.—Vapour very pleasant to breathe. Quantity of fluid required for complete anæsthesia, 8 to 12 drachms. Required charge of air by vapour 10 to 15 per cent. Anæsthesia moderately quick, with rather long spasmodic stage and, occasionally, vomiting.

Anæsthetic value.—A good anæsthetic, but too volatile for ordinary use as a fluid.

Date of introduction, 1849.—T. Nunneley. J. Snow, M.D., and B. W. Richardson, conjointly (1852).

Ethyl Hydride (C_2H_5H).

Physical properties.—A gas at ordinary temperatures. Vapour Density, 15. Solubility in blood undetermined. Burns in air.

Physiological properties.—Generally the same as for amyl hydride, described on page 260.

Anæsthetic value.—Practically the same as for amyl hydride, but less manageable, owing to its being a gas.

Date of introduction, 1867.—B. W. Richardson, M.D.

Ethyl Oxide, Ethylic Ether ($C_4H_{10}O$).

Physical properties.—A colourless, mobile fluid, Sp. Gr. 0·720. Vapour Density, 37. Boiling-point, 35°C., 95° F. Solubility in blood 1 part in 10 at 98° F. Vapour burns in air.

Physiological properties.—Vapour rather oppressive to breathe, and to some irritating. Quantity required for complete anæsthesia, 6 to 12 fluid drachms. Required charge of air by vapour at 60° F. 20 per cent. Action steady and rather slow, with moderate spasmodic stage. Recovery slow, and followed often by nausea, ethereal eructation, and oppression. Reduction of animal temperature in deep anæsthesia, 2° F.

Anæsthetic value.—Considered, altogether, to be the safest practical anæsthetic for general surgery. Administration has nevertheless been attended with fatal results. Andrews' estimate of one death to 23,204 administrations is probably an understatement. In death by ether the circulation, as a rule, outlives the respiration; in animals always, according to my observation.

Date of introduction, 1844-5.—Horace Wells. W. T. G. Morton, M.D. (1846). C. T. Jackson, M.D. (1846). First operation under ether by Morton, September 30th, 1846.

Ethene, Olefiant Gas (C_2H_4).

Physical properties.—A permanent gas at ordinary temperatures. Vapour Density, 14. Solubility in blood undetermined. Burns in air.

Physiological properties.—Inodorous and pleasant to breathe. Required charge of air by gas, 10 to 15 per cent. Anæsthesia rapidly produced, with short spasmodic stage. Recovery rapid, without bad effects.

Anæsthetic value.—A good anæsthetic, but inconvenient from being a gas. Respiration ceases before the circulation.

Date of introduction, 1849.—T. Nunneley. B. W. Richardson, M.D. (1865).

Ethene Chloride (Dutch Liquid) ($C_2H_4Cl_2$).

Physical properties.—A colourless sweet fluid of pleasant ethereal odour, Sp. Gr. 1·271. Vapour Density, 49·5. Boiling-point, 85° C., 185° F. Solubility in blood undetermined. Vapour burns in air with green light.

Physiological properties.—Vapour pleasant to inhale. Quantity required for complete anæsthesia, 2 to 8 fluid drachms. Required charge of air by vapour 5 to 10 per cent. Stages induced slowly, with rather long spasmodic period. Recovery slow, with, in rare cases, vomiting.

Anæsthetic value.—A good anæsthetic, very much like chloroform in its action, but less rapid. Circulation and respiration fail, under it, together. Deserves more experimental study.

Date of introduction, 1846.—Sir J. Simpson, M.D. John Snow, M.D. (1848). R. Glover, M.D. (1848). B. W. Richardson, M.D. (1851).

Ethene or Ethylene Dichloride (Monochlorinated Chloride of Ethyl) ($C_2H_4Cl_2$).

Physical properties.—A colourless fluid, Sp. Gr. 1·174. Vapour Density, 49·5. Boiling-point, 64° C., 147·2° F. Solubility in blood undetermined. Vapour burns in air with greenish flame.

Physiological properties. — Vapour pleasant to breathe. Quantity required for complete anæsthesia, 2 to 8 drachms. Required charge of air by vapour from 5 to 10 per cent. Anæsthesia produced rather more rapidly than by chloroform, with second or spasmodic stage sometimes acute. Recovery easy, and with no important after-effects. Vomiting a less frequent accompaniment than after chloroform.

Anæsthetic value.—Snow, who introduced this anæsthetic, and who was seized with his fatal attack while writing upon it, told me he estimated its value as equal to chloroform—an estimate which has been sustained by later experience. The anæsthetic has, however, more than once proved fatal, apparently from failure of the circulation, although in my own experiments with it on lower animals I once restored a rabbit to life by artificial respiration 7 minutes after the natural respiration had ceased.

Date of introduction, 1851.—J. Snow, M.D. O. Liebreich, M.D. (1869). B. W. Richardson, M.D. (1871).

VI.—Methyl and Methene Series. Anæsthetic Base, Methyl (CH_3). A gas. Vapour Density, 7·5. Methene (CH_2). A gas. Vapour Density, 7.

Methylic Alcohol (CH_4O).

Physical properties.—A colourless spirit, Sp. Gr. 0·810. Vapour Density, 16. Boiling-point, 60° C., 140° F. Freely soluble in blood, but precise solubility undetermined. Vapour burns in air.

Physiological properties.—Vapour pungent to breathe, and slightly provocative of cough. Quantity of fluid required for complete anæsthesia, from 1½ to 2 ounces, by volume. Required charge of air by vapour, to saturation. Action very slow, and with distinct symptoms of alcoholic intoxication. A full hour required to produce insensibility, which at the deepest is insufficient to destroy reflex irritability. Breathing stertorous, often with bronchial rale. Recovery very slow, four to six hours in deep anæsthesia. Temperature reduced 3° F.

Anæsthetic value.—Indifferent, owing to length of administration and slow recovery, but danger practically *nil.* When the inhalation is enforced to the production of death, the circulation and respiration cease simultaneously.

Date of introduction, 1867.—B. W. Richardson, M.D.

Methyl Bromide (CH_3Br).

Physical properties.—An extremely volatile fluid, Sp. Gr. 1·660. Vapour Density, 47·5. Boiling-point, 10° C., 50° F. Solubility in blood undetermined. Vapour burns in air.

Physiological properties.—Analogous to those of ethyl bromide, described on page 264, but causing more irritation, with salivation.

Anæsthetic value.—Analogous to ethyl bromide, but less practical, owing to extreme volatility and lesser steadiness of action.

Date of introduction, 1867.—B. W. Richardson, M.D.

Methyl Chloride (CH_3Cl).

Physical properties. — A colourless gas. Vapour Density, 25·25. Solubility in blood undetermined. Burns in air with pale green flame.

Physiological properties.—Gas very pleasant to breathe. Required charge of air, 15 per cent. Anæsthetic action rapid and most effective, with the briefest spasmodic stage, or with no such stage. Insensibility deep. Recovery rapid, not longer than five minutes from deepest narcotism, and with no bad after-effects. Vomiting very rare.

Anæsthetic value.—One of the best and safest of anæsthetics; safest of all anæsthetics containing chlorine, but difficult of management, owing to its being a gas. Carried to the point of production of death, the heart outlives the respiration, and the muscles retain their irritability after death for periods of three to four hours. The heart pulsated spontaneously, in one case of a rabbit, killed by the vapour, for forty minutes.

Date of introduction, 1867.—B. W. Richardson, M.D.

Methylic Ether (C_2H_6O).

Physical properties.—A colourless gas. Vapour Density, 23. Solubility in blood 30 volumes at 98° F. Burns in air.

Physiological properties.—Gas pleasant to breathe and causing no irritability. Required charge of air 25 per cent. Anæsthetic action rapid up to complete insensibility, without any manifestation of spasmodic stage. Possesses remarkable property of destroying sensibility before destroying consciousness. Recovery from deep anæsthesia rapid, and unattended by any bad symptom or vomiting. Temperature reduced 1° to 2° F. in deep anæsthesia.

Anæsthetic properties.—I consider methylic ether to be the safest of all anæsthetics hitherto discovered. Pigeons and rabbits will remain anæsthetised in a full anæsthetic atmosphere for twelve minutes without dying, and allowed to die are recoverable by artificial respiration seven minutes after cessation of all signs of life. The one practical objection to methylic ether as an anæsthetic consists in its being a permanent gas at ordinary temperatures. I have administered it successfully twenty-seven times to the human subject.

Date of introduction, 1867.—B. W. Richardson, M.D.

Methene Chloride (Methylene Bichloride) (CH_2Cl_2).

Physical properties.—A colourless fluid, Sp. Gr. 1·434. Vapour Density, 42·5. Boiling-point, 40° C., 104° F. Solubility in blood not correctly determined. Vapour burns in air with a pale green flame.

Physiological properties. — Vapour pleasant to breathe and not irritating. Quantity of fluid required for anæsthesia, 1 to 6 fluid drachms. Required charge of air 5 to 10 per cent. Action rapid, with short but rather acute spasmodic stage. Insensibility perfect. Recovery rapid, and usually without bad symptoms. Vomiting about once in six administrations. Animal temperature reduced from 2° to 3° F. under deep anæsthesia.

Anæsthetic value.—Pure methene chloride is one of the best anæsthetics, but not free from danger. The deaths from it have been estimated at 1 in 7,000 administrations.

Date of introduction, 1867.—B. W. Richardson, M.D.

Methenyl Chloride (Chloroform) ($CHCl_3$).

Physical properties.—A colourless fluid, Sp. Gr. 1·525. Vapour Density, 61·75. Boiling-point, 60° C., 140° F. Solubility of vapour in blood, 1 in 16,285 according to Snow, but not correctly determined. Vapour extinguishes flame.

Physiological properties.—Vapour slightly pungent, but pleasant to inhale. Quantity of fluid required for anæsthesia, 1 to 8 fluid drachms. Required charge of vapour in air, 5 per cent. Action steady and determinate, with, as a rule, a sharp, spasmodic stage. Recovery moderately rapid, without bad after-results. Vomiting once in nine administrations (Snow). Animal temperature reduced from 2 to 3 F. during deep anæsthesia.

Anæsthetic value.—One of the most ready and largely used of anæsthetics. Deaths from it probably 1 in from 2,500 to 3,000 administrations.

Date of introduction, 1847.—Sir James Simpson, M.D.

Methane, Methyl Hydride, or Marsh Gas (CH_4).

Physical properties.—A colourless gas. Vapour Density, 8. Solubility in blood undetermined. Burns in air.

Physiological properties.—An odourless gas, breathed without irritation. Quantity required in air for anæsthesia, 35 per cent. Anæsthesia slowly induced, without any active spasmodic stage.

Anæsthetic value.—A very good anæsthetic, but not practical, owing to its being a gas.

Date of introduction, 1849.—T. Nunneley. B. W. Richardson, M.D. (1867).

Methylal ($C_3H_8O_2$).

Physical properties.—A colourless fluid, Sp. Gr. 0·855. Vapour Density, 38. Boiling-point, 42° C., 107·6° F. Solubility in blood, 1 part in 3. Vapour burns in air with some difficulty.

Physiological properties. — Vapour agreeable to breathe. Quantity required to produce anæsthesia, from 1 to 3 fluid ounces. Required charge of vapour in air 35 per cent. Anæsthetic action extremely slow, and in almost all respects like methylic alcohol. Recovery very prolonged, but without painful symptoms or vomiting.

Anæsthetic value.—The same as for methylic alcohol, described on pages 268-9.

Date of introduction, 1868.—B. W. Richardson, M.D.

VII.—Nitrogen Series. Anæsthetic Base, Nitrogen (N)? A gas. Combining weight 14.

Nitrous Oxide (Laughing Gas) (N_2O).

Physical properties.—A gas. Vapour Density, 22. Solubility in blood not accurately determined. Supports combustion. Is condensible into a liquid under pressure of 30 atmospheres at —88° C.,—126·4° F.

Physiological properties.—Inodorous gas, breathed without any irritation, and producing, rapidly, deep insensibility, which cannot, however, be long sustained. Recovery rapid. Diluted with air, the insensibility, much less perfect, is attended with great emotional excitement. Mode of producing anæsthesia different from that of all other anæsthetics, except carbonic acid, which, in regard to the asphyxia induced by it, it much resembles.

Anæsthetic value.—Is an admirable anæsthetic for short operations, and although not absolutely free from danger, death having occurred under its influence, is unquestionably by far the safest of all known general anæsthetics. Deaths probably not more than one in 100,000 administrations. The administration is attended, occasionally, with prolonged after-effects of dyspepsia and vertigo.

Date of introduction.—1800. Sir Humphrey Davy. Horace Wells (1844).

The first operation inaugurating the era of modern anæsthesia was upon Horace Wells himself, for extraction of a tooth under the influence of nitrous oxide, on December 11th, 1844, at Hartford, Connecticut. Administrator, Mr. G. Q. Colston; operator, Dr. Riggs.

VIII.—Terpene Series. Anæsthetic Base, Turpentine ($C_{10}H_{16}$). An oil. Vapour Density 68.

Turpentine ($C_{10}H_{16}$).

Physical properties.—Colourless fluid, Sp. Gr. 0·865. Vapour Density, 68. Boiling-point, 160° C., 320· F. Solubility in blood undetermined. Vapour burns in air.

Physiological properties.—Vapour irritating at first and difficult to breathe, but productive, slowly, of deep anæsthesia, accompanied with convulsive rather than tetanic movements. Recovery slow, as if from deep intoxication.

Anæsthetic value.—Indifferent, but has been used on the human subject, in emergency, with success, in the absence of a better anæsthetic. Has also been added to chloroform for inhalation with the idea of preventing collapse from chloroform.

Date of introduction.—1849. T. Nunneley.

IX.—Series of Anæsthetic Mixtures.

At various times mixtures of one or more of certain of the anæsthetics included in the preceding series have been brought into practice, and require to be named in order to render this Synopsis complete.

Vienna Mixture.

Vienna mixture is made by combining 8 parts of ether with 1 part of chloroform in hot weather; 6 parts of ether with 2 parts of chloroform in cold weather.

Physical properties.—A fluid, very unstable, the ether boiling at 96° F., the chloroform at 140° F., with the vapour density of the ether 37, of the chloroform 59·75.

Physiological properties.—Vapour pleasant to inhale.

Quantity of fluid required for anæsthesia 4 to 8 fluid drachms. Action determined, and recovery rather more rapid than after ether alone. Vomiting more frequent and severe, according to the experience of the author, than from chloroform.

Anæsthetic value.—The mixture, first used in Vienna, was so much approved of there that a local law was passed that it should be the only anæsthetic employed. It was reported to have been administered 33,000 times without one fatal result. In 1860 author administered it thirty times, but gave it up, owing to the severity of the vomiting induced by it.

Date of introduction.—1856, *circa.* Doubtful by whom introduced.

Alcohol, Chloroform, and Ether Mixture.

(*Commonly called the A.C.E. mixture.*)

This mixture is made by combining absolute ethylic alcohol of Sp. Gr. 0·795 with chloroform and ethylic ether. Proportions vary with different administrators. Present author thinks four parts ether, two parts chloroform, and two parts alcohol, by fluid measure, the best proportions.

Physical properties.—A fluid, very unstable, having three different boiling-points and vapour densities.

Physiological properties.—Vapour pleasant to inhale. Quantity required to produce anæsthesia, 4 to 8 fluid drachms. Is fairly regular in action, effective, and altogether a good combination. Recovery from it is rather slow, but after-effects are not severe. Vomiting is not very frequent.

Anæsthetic value.—Altogether a very good mixture. No record has yet been given of a death from this anæsthetic.

Date of introduction.—1866. Robert Ellis.

Hydramyle.

A mixture made by adding amyl hydride to zinc in making methylene bichloride from chloroform.

Physical properties.—A colourless, ethereal fluid. Sp. Gr. 0·720.

Physiological properties.—Vapour ethereal, sweet, and very pleasant to breathe; quantity required to produce anæsthesia, 2 to 4 fluid drachms. Action extremely rapid, complete insensibility sometimes occurring within the minute. Peculiar in its effect in that insensibility from it intensifies for a few seconds after it is withdrawn. Recovery, when it commences, almost immediate.

Anæsthetic value.—An excellent anæsthetic for short operations like extraction of a tooth. Was administered by author forty-six times to the human subject, with production of insensibility within an average of fifty seconds, and without vomiting or any other untoward symptom.

Date of introduction.—1871. B. W. Richardson, M.D.

Methylene Ether.

A mixture produced by combining equal parts of absolute ethylic ether with methylene bichloride.

Physical properties.—A colourless fluid, more stable than the other anæsthetic mixtures, the vapour density of ether being 37, of methylene 42·5; the boiling-point of ether 96° F., of methylene 104° F.

Physiological properties.—Vapour pleasant to inhale. Quantity required for complete anæsthesia, 2 to 8 fluid drachms. Action steady and rapid, with very slight spasmodic stage. Recovery quick, with few bad after-effects, and vomiting infrequent.

Anæsthetic value.—An exceedingly good combination, and deserving a further trial than it has received. Author administered it thirty times with most satisfactory results. One death occurred, in the practice of Mr. Lawson Tait, from administration of a fluid supposed to be this mixture, but which contained chloroform in large proportion. In death of lower animals in this vapour circulation survives respiration.

Date of introduction.—1870. B. W. Richardson, M.D.

Methylic-Ethylic Ether.

A mixture made by saturating ethylic ether with methylic ether gas.

Physical properties.—Colourless liquid of Sp. Gr. 0·720. Very unstable and inflammable.

Physiological properties. — Extremely pleasant to breathe, and yielding all the effects of methylic ether, except that anæsthesia is slower and more prolonged.

Anæsthetic value.—Would be amongst the most valuable of anæsthetics if it were more stable and practical in application.

Date of introduction.—1867. B. W. Richardson, M.D.

Compound Anæsthetic Ether.

A mixture of equal parts of absolute ethylic ether and of amyl hydride (rhigolene).

Physical properties.—A light fluid. Sp. Gr. 672. Boiling-point, 90° F.

Physiological properties.—Pleasant to breathe, and a rapidly acting anæsthetic, but discovered to be dangerous, causing death in the lower animals, suddenly, from cardiac paralysis.

Anæsthetic value.—Is not recommendable as a general anæsthetic, and has once been a cause of death in man. For producing local anæsthesia from cold in the form of spray is good, and is generally employed.

Date of introduction.—1868. B. W. Richardson, M.D.

COTEMPORARY PRACTICE AND LITERATURE.

> "*Every physician will and ought to make observations from his own experience; but he will be able to make a better judgment and juster observations by comparing what he reads and what he sees together.*"—FRIEND.

ALCOHOLIC PARALYSIS.

DR. HENRY HUN, in a paper on Alcoholic Paralysis, published in the last number of the *American Journal of the Medical Sciences*, April 1885, contributes, in a very careful study, a brief but clear history of his subject, in which the labours of Magnus Huss in 1852, of Lancereaux in 1864, of Dr. Wilks in 1867, of Dr. R. Glynn in 1883, and of Dr. Broadbent in 1884, are ably recognised. Dr. Hun expresses that we are justified in regarding alcoholic paralysis as a special form of disease, with the following symptoms. After a number of cerebral and gastric disturbances due to the alcoholic poisoning, the symptoms of the disease proper commence with neuralgic pains and paræsthesiæ in the legs, which gradually extend to the upper extremity, and which are accompanied at first by hyperæsthesia, later by anæsthesia, and in severe cases by retardation of the conduction of pain. Along with these symptoms appears a muscular weakness which steadily increases to an extreme degree of paralysis, and is accompanied by rapid atrophy and by great sensitiveness of the muscles to pressure and to passive motion. Both the sensory and the motor disturbances are symmetrically distributed, and the paralysis attacks especially the extensor muscles. In addition to these motor and sensory symptoms there is also a decided degree of ataxia. The tendon reflexes are abolished, and vaso-motor symptoms, such as œdema and congestion, are usually present. Symptoms of mental disturbance are always present in the form of loss of memory, and in transient delirium.

The lesion is in all probability a degeneration of the peripheral nerve fibres and of the nerve cells in the cerebral cortex, together with a chronic congestion or inflammation of the pia mater. This lesion explains well the symptoms, although it is certainly curious that alcohol should not attack the spinal cord, but only the highest and lowest part of the nervous system, if one may so call the cortex of the brain and the terminal branches of the peripheral nerves.

CUTANEOUS AND DEEP REFLEXES.

IN the same number of the *American Journal of the Medical Sciences*, April 1885, Dr. Philip C. Knapp records a series of observations upon the cutaneous and deep reflexes of 239 persons, from which he draws the following conclusions:—

1. Absence of the plantar or cremaster reflex is usually pathological, depending upon a direct lesion of the reflex arc, or some cerebral disturbance.

2. Absence of the other cutaneous reflexes is not necessarily pathological.

3. Absence of the patellar reflex may be due to cerebral disturbance, especially in alcoholic subjects.

4. Ankle and patellar clonus are pathological.

5. The deep reflexes of the upper extremity are of frequent occurrence, and have no special pathological significance.

6. The costal reflex is found in the majority of cases without general exaggeration of the reflexes, and with no signs of phthisis, incipient or advanced.

7. When the reflexes differ on the two sides, though it usually signifies some unilateral disease of the nervous system, it is not always pathological.

Finally his observations have led him to emphasize the value of testing all the reflexes, cutaneous and deep, in the upper extremity as well as in the lower, and on the two sides of the body, in examining patients with nervous diseases.

COINCIDENT VARIOLA AND VACCINIA.

DR. C. E. ROWLING reports in the *Australasian Medical Gazette*, of February 15th of the present year, pp. 114-15, a series of very important facts, bearing on the relationships of variola to vaccinia. A man, aged twenty-seven, presented himself to Dr. Rowling, stating that he was living in a house where there had been three cases of small-pox; and, as he was unvaccinated, he solicited advice. Dr. Rowling vaccinated the man immediately in four places on each arm. The following day the man had pains in his back, and 102·6° F. of fever. Next day the temperature rose to 103°, and variolous eruption was declared, forty-three umbilicated pustules appearing on the body,—three on the face, eleven on the chest, seventeen on the back, and the rest on the legs. In due time the vaccinia took also its course. The vaccination was successful in every place, eight well-developed Jennerian vesicles appearing, four on each arm. The small-pox ran a very mild course. The case so far is full of interest, but the most important part has to be related. Dr. Rowling, with two other medical friends, vaccinated a child eight months old from the clear lymph of one of the Jennerian vesicles on the arm of the variolous vaccinia patient, the result being that nothing but a normal attack of vaccinia occurred. They then vaccinated thirteen others, eleven of which were successful, two negative.

Dr. Rowling considers that this experience affords proof direct that vaccination carefully performed yields no result except vaccinia; and it would certainly be difficult to possess any evidence more thoroughly crucial.

TUMOURS OF THE OVARY, FALLOPIAN TUBE, AND BROAD LIGAMENT.

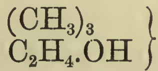
MR. ALBAN DORAN, in his new work (Smith, Elder & Co.) on the above subject, has written a book which will not easily be lost in the literature of medicine. It may not, at this moment, be destined to receive all the credit it deserves, for it is a book that must be studied in order that it may be understood; but it carries its mark all through as emanating from an observer whose industry is only paralleled by his conscientiousness. In 1877, Mr. Doran joined the staff of the Samaritan Free Hospital, and since then he has assisted at nearly seven hundred abdominal sections. In November 1877 he determined to take brief notes of every case that came under his observation, and in this manner he has succeeded in collecting the material upon which his present work is founded.

On the questions of statistics of ovariotomy,—the merits of the antiseptic system, the use of the drainage tube, the weight of tumours and the nature of their fluid contents,—the author is silent. But he has found ample scope for communication of new instruction on a number of other less known, and yet equally important topics, such as the origin of the common multilocular ovarian cyst, solid tumours of the ovary, rupture of ovarian cysts, twisting of the pedicle, the abdominal wound with notes on adhesions, morbid conditions of the kidney associated with ovarian tumours, and tumours of the Fallopian tube.

The general object of the author is to present to his readers the latest advances in pathology, but here and there we have brought before us little bits of practical diagnosis which are most suggestive and useful. Thus in pages 35 to 39, in the chapter on multilocular and glandular ovarian cysts, we have introduced to us, almost incidentally, what is really a distinct essay or lecture on points of diagnosis. It is worth the bestowment of an hour of the time of the busiest practitioner to read up this section, in which no detail is considered too trifling for notice, and no grouping of details too deliberate. The condition of the examiner himself is even considered: he must not have cold fingers, which cause contractions of the patient's abdominal muscles, and which do not possess the proper degree of tactile sensibility; and he must not wear tight-fitting gloves for several minutes before he commences his manipulation, for they produce numbness and deficient delicacy of touch.

These are only one or two points in illustration. To comprehend the unusually important matter which Mr. Doran has written in this volume, its simplicity of method derived from the comprehensive knowledge of the methodizer, and its practical worth, readers must consult the volume on their own account. They will not be dissatisfied if this brief description of it should lead them to the perusal of a series of essays which the present writer very reluctantly leaves with so short and inadequate a notice.

CHOLINE (NEURINE) IN HOPS.

DRS. GRIESS and Harrow report in the *Journal of the Chemical Society* for May 1885 (Van Voorst) the very interesting discovery which they have made of the presence of choline or neurine in hops. Choline, the rational formula of which is  $\left.\begin{matrix}(CH_3)_3\\ C_2H_4.OH\end{matrix}\right\}$ N.OH, is a constantly recurring constituent of several organs of the body, as the brain, and has also been proved to exist in some plants. It was prepared synthetically by Wurtz by the action of ethylene oxide on trimethylamine. The authors have found it is also present in hops, from which they isolated it by the following method. To a concentrated aqueous extract of hops, acidified with hydrochloric acid, a sufficient quantity of a solution of iodine in hydriodic acid was added. In this way a blackish, semi-solid precipitate was obtained, which occasionally crystallised in slender, shining needles, and, no doubt, consisted of a choline periodide. Separated from the mother-liquors, and boiled with water, it was converted into the very easily soluble choline iodide, vapour of iodine being at the same time evolved, and a tarry mass deposited. The free base was obtained, although at first in a very impure state, by treating the choline iodide with silver oxide, and evaporating the filtered solution on the water-bath. The base, purified and freed from water as far as possible by evaporating its solution on the water-bath, forms a thick, strongly-alkaline syrup, which solidifies in the desiccator to an extremely hygroscopic crystalline mass; it quickly absorbs carbonic anhydride, has a caustic and somewhat bitter taste, is quite odourless, and is decomposed at a high temperature with formation of trimethylamine.

Regarding the mode of combination and the quantity in which choline exists in hops, the learned authors reserve judgment. They think it not improbable that choline exists in hops in loose combination with resin, and that such a combination may form that bitter principle of hops which is easily soluble in water. As to quantity, they have not been able to procure more than about one-fiftieth per cent. Whether choline is present in the hop, the solution of which forms a constituent of beer, is a question which they are not in a position to decide.

SUICIDE.

DR. W. WYNN WESTCOTT, deputy-coroner for Central Middlesex, in what he calls a "Social Science Treatise" (H. K. Lewis), has brought together a series of facts bearing upon the history, literature, jurisprudence, causation, and prevention of suicide. The work will prove of interest and of value to the general as well as to the professional reader. In it we are offered much information on the present rate of suicide in Europe, as modified by race, climate, education, religion, morality, urban and rural life and employment, military, naval, and prison life, times and seasons, age, sex, social state, and mental diseases. Respecting the influence of religion on the proportions of suicide in Europe, Dr. Westcott shows that the maximum rate constantly falls to Protestant states, next to the Roman Catholic, then to the Greek Church, and, lastly, to the Jews, in whom the minimum is represented.

An average, estimated from a large collection of numbers by Morselli, shows that the ratio is 58 per million in Catholic states, 190 per million in Protestant states, and in the Greek Church 40 per million; but the low suicide rate of the Slavonic races renders conclusions as to the Greek Church most unreliable. It seems to the author that this is not an accurate deduction from the relative numbers, the proportion allotted to Protestant countries being much too high.

Legoyt gives Catholics 62, Protestants 102, Greek Church 36, Jews 48; and this seems an estimate nearer to the truth. Curiously enough, Catholics far exceed Protestants in the statistics of total crime in all countries.

In general, as a result of the sum of religious statistics, too numerous and voluminous for quotation here, we may generalize and say that Catholics incline to suicide through madness, following their vices, while Protestants fly to suicide as relief from domestic troubles, monetary anxieties, remorse for wasted opportunities, and regret for the absence of hoped-for results;

they are also more liable than Catholics to suicide following religious mania.

On the question of seasons and times of suicide, the author shows that the maximum rate of suicide occurs 88 times in summer as opposed to winter; in spring nine times. The minimum of suicide occurs in winter 88 times, and in autumn 12 times per cent. out of the same number of observations. Suicide increases from January to July, and then decreases, month by month, to the end of the year. In England, amongst men, suicide is most common in the beginning of the week. Monday yields the highest number of suicides, Saturday the lowest. Amongst women, Sunday yields the highest number. In respect to hours, from 6 a.m. to 10 a.m., about noon, and from 2 to 3 p.m. have very much the highest numbers. The rate diminishes almost regularly from 3 p.m., through midnight to 3 a.m., when the lowest number is reached. Dr. Westcott's book is one which is certain to command a distinctive and wide popularity.

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RELATIVE POISONOUS PROPERTIES OF ORDINARY COAL GAS AND WATER GAS.

MR. S. W. ABBOTT, Health Officer of the Commonwealth of Massachusetts, has been good enough to send me,—*apropos* to researches on the lethal chamber published in ASCLEPIAD No. 5,—a report respecting the relative poisonous qualities of common illuminating coal gas, and the so-called water gas, and their probable effects upon the public health. It is known that the chief poisonous ingredient of common coal gas is carbonic oxide (CO), and it was therefore determined by the Commonwealth of Massachusetts to ascertain if the new illuminating gas, called Water Gas, contains more or less of the poisonous carbonic oxide. The inquiry, conducted by Professors W. T. Sedgwick and W. Ripley Nichols, led to the discovery that while common illuminating coal gas yields 7 per cent. of carbonic oxide, water gas, supplied to two towns called Middletown and Athol, contains 30 per cent. of the gas. The experimentalists afterwards tested the effects of the two gases, separately, on animals in a room of 700 cubic feet, by which they found that extreme poisonous effects were well developed in the water gas in an hour and a-half, while in the ordinary gas the same effects were not produced until eight hours. The reporters, therefore, came to the conclusion that water gas is too dangerous to be employed for illuminating purposes. To this report Dr. Abbott adds the following memorandum: "Water gas, so called, is now largely used for illuminating purposes in many of the large cities of the United States. But, in view of the large amount of carbonic oxide contained in it, it is now practically prohibited in Massachusetts by a statute limiting the percentage of carbonic oxide in illuminating gas to 10 per cent. Since the introduction of water gas into New York city, the deaths by accidental inhalation of illuminating gas (during its escape from burners while people were asleep) have increased about tenfold, the total deaths since its introduction in that city in 1878 having been nearly one hundred."

This practical lesson from the other side of the Atlantic deserves to be borne steadily in mind here in relation to the supply of gas to our great communities.

MANUAL OF HEALTH SCIENCE.

DR. ANDREW WILSON has done well in publishing through Messrs. Longmans his useful little "Manual of Health Science." The book is a compendium. It opens with a physiological description, giving in brief terms an outline of the general functions of the body. It passes next to food, diet, and cooking; then to the air we breathe; the removal of waste matters; the local conditions of health, shelter, and warming; personal health; ambulance work, or first aid to the injured; and infectious diseases and disinfection. At the close of the work a series of questions is supplied, by which the student may, if he be so disposed, test his own knowledge from his readings, and prepare himself for examination on hygienic subjects, as indicated, for example, in the syllabus on Health issued by the Science and Art Department.

That Dr. Wilson's manual is written in a clear and forcible style is natural, because as a public teacher his well-marked and well-known qualities are clearness and force. There is nothing superfluous in any chapter; there is nothing omitted that is of intrinsic value.

DISEASES INCIDENT TO PUBLIC LIFE.

POLITICAL Niagara just now coming into full play, with the advent of a new Parliament refounded on new lines, is giving an impulse to all sorts and conditions of men to enter the political arena and seek in new scenes of strife for the bubble reputation.

Whether this political torrent is to be for good or bad for the country at large, whether it is going to breed statesmen or underbreed statesmanship, are points on which a physician need offer no opinion. For all that, he has a duty which may be conscientiously discharged, which is entirely within his own province of observation, and which, touching as it does the fate of the new national experiment in certain of its stages, is in correct place here at the present juncture.

To all who have had under their observation the phenomena of motion in the physical and mental life of man until the phenomena have become an open book, it is clear that coming political events will, if they do nothing else, lead to great changes in the health of those who, as legislators, are to play the most important parts, for good or for evil, in the impending revolution. In plain words, some of the men who may succeed in entering the House will, of necessity, suffer from diseases which are almost inseparable from public life and the risks of which they must meet in accepting the so-called honours which their ambition or their desire to serve their country leads them to obtain.

The character of the diseases that will be manifested will vary with the characteristics of the individual for the nature of the work that has to be done in the parliamentary struggle. In the work there are three perils, two of which affect different persons differently, and one of which affects all more or less, as a common peril. The first is the conflict, always in progress, connected with hopes deferred, passions ignited, excitements of victory, depressions of defeat. The second is the out-door work of the parliamentarian; the preparation for debate or vote; the perusal of the public opinion expressed outside the House by speeches, leading articles, and correspondence, and the friction of mind and physical labour connected with attendance at public meetings, committees, deputations, dinners and the various other public entertainments. The third peril which affects all in common is the late sitting, the night work of the legislating labourer, with, on latest nights, the last great excitement of the conclusion of debate at the time of year and at the hours when, under favourable conditions, the human body is at its lowest natural ebb; the hours of hours in which the stricken to death most frequently yield up their last breath to the eternal space.

The diseases most commonly incident to the public life are almost entirely those which affect the bodily organization through the mental surface.

They are the results, either of intense shocks driven through the senses from without and deranging the molecular or molar construction of surface; or of persistent friction between the immutable spirit flowing in regular tides into the mutable flesh and preventing its repose for efficient repair of its structure; or persistent friction on one particular centre of the mental surface, with failure of it and of all parts subordinate to it as a centre of power.

Thus in the phenomena of disease which we observe in the men unfitted constitutionally for public life, the grand series are diseases of that fleshy physical surface, the nervous system, on which the mind is distributed; that resident medium of the mental motion derived from outside the organism, which entering the camera nervosa by the senses, is reflected back in act, word, deed.

The diseases incident to the series of induced changes by mental shocks are most developed in emotional and animal emotional men. The shocks tell in them, through the sympathetic nervous organization, on vital organs, and especially on the heart. The heart is being kept in continual perturbation, its nervous supply irregular, intermittent, palpitating. Whatever other part of the body may be deprived of power, the regulating heart must never be deprived. "First come first served" is the rule of the heart; and so it takes, literally, for its own use, and for its own special nourishment, the very first drops of blood which it pumps out at each of its strokes. If it fail in this process, through the wrong done to it by its owner, it immediately suffers. The coronary arteries,—the primary branches of the great arterial tree which rises from the left ventricle of the heart,—failing to bring round to the muscular walls of the heart sufficient food for their support, the nutrition of the heart itself is earliest to suffer; then, as the nervous supply which prompts the muscular action is reduced, there occurs a further failure; and, lastly, as the nervous surface which is the seat of the nervous power must have its required blood supply reduced when the centre fails, there is a third bad effect telling back upon the central vital organ; the whole leading to a disablement from the centre under which many public men succumb during subjection to excitements they were not able to encounter.

The illness and death of Mirabeau, as told by his compatriot Cabanis, is a perfect illustration of an emotional statesman killed from the heart by excitement, killed as if he had been stabbed to the heart, and had died a lingering death from loss of blood.

In one of our public institutions there is a model likeness of one of the political heroes of the working men of this country, who died so like Mirabeau that if Cabanis' account of the death of the great statesman were changed by the mere alteration of the names of the sufferers, the clinical record would read for either the one or the other. They were, socially, very different men—the one a patrician and scholar, the other a plebeian and a self half-taught. But constitutionally they were the same, in accident of political strife the same, in result of disease the same, in suffering the same, in mode of death the same. At the generous instance of the late Mr. Danby Seymour, I was the consultant called to render physician's aid to the English political enthusiast, who was as sincere a man as he was intense and unselfish. And my return of him in the clinical note-book reads, "Intermittent circulation and disorganized heart from political excitement and enthusiastic worry." This man told me that he dated the knowledge of his symptoms, his breathlessness and failure of central power, to some rough physical usage to which he was subjected while descending from a waggon from which he had been addressing a multitude. I have no doubt that was the turning-point of his failure, but it had been led up to by long previous strain.

A few professional and political friends, including, on the professional side, the late Dr. Edwin Lankester, and myself, were steaming down the Thames to see the great outfall for the London sewage. We had with us a friend we knew well, a scholar, a well-known publicist, a strong vehement emotional politician with an historical name as such. On the way this enthusiast broke forth into one of his vehement political arguments, and while speaking suddenly stopped. He held out his hand for me to feel his pulse, which was intermitting as if it would cease altogether. When he had quite calmed down he took me aside, and described to me his condition, the same, in kind, as told by Cabanis of Mirabeau, but less advanced. I warned him. "If you repeat these vehement outbursts, you will one day empty your heart into your brain, and then and there end all your fervour." He called out to Lankester to come, and repeated to him my statement as a saying pithy he thought, but rather a play upon words than of serious import. "I agree," said Lankester, "and would advise you to take the hint." He, however, the man most concerned, treated the matter as a false alarm, went on in his career unchecked, and one day, not long afterwards, while delivering in public an impassioned speech against American slavery, died on the platform, as we had foretold. He emptied his feeble heart into his powerful brain. These are extreme examples in respect to the sudden endings of public life, but are of great value as lessons. They are the understandable illustrations of a number of other examples, minor in appearance as phenomena, but only just short of seriousness in fact. In the prolonged form, in slow collapse from central failure, in breaking down, as it is commonly called, such examples are numerous amongst public men of the emotional type, and if the experience of other physicians be the same as my own, they are, year by year, on the increase.

Sometimes, especially amongst men of the emotional, and still more amongst men of the animal emotional type, an opposite condition obtains. In their excitement, commenced early in life, their heart becomes too powerful for their body. It becomes an uncontrollable organ. Its nervous organization is most impressionable, its own brute power, if I may use the expression, out of balance with the rest of the body. In these cases the mental nervous surface is the sufferer. The man is said to be very excitable, to fire off quickly, to be unmanageable by any authority. For a time this power is long evidenced, and troublesome to all whom it affects; then it is noticeable as being subject to sudden arrest in him in whom it is manifested. He is violent as ever for a period, but on slight opposition he sits quietly down, reposes a while, and soon gets up again, repeating the act until the repetition becomes a more serious impediment to business than the former long and vehement harangues. Lookers-on say of the man, "Let him have it out, and have done with it;" they try the experiment, but it does not succeed, for he never has done with it. He has got into the fits and starts stage of emotional disease. He is the irresponsible possessor of a strong unbalanced heart hammering a feeble brain into illucid intervals of helpless imbecility. Men of this kind sink into disease from the brain. They often die of apoplexy, which in plain English means a blow or stun, as if they were knocked down, like oxen, by a blow on the head. In fact they are, except that the last blow is delivered from the inside instead of the outside of the organism.

In other examples the blow is not sufficient to kill outright; it is a "stroke," a stroke of palsy,—so it is expressed. One controlling part, and no more, of the nervous surface gives way; the arm falls, or the lip falls, or the half of the body loses its power, and the correct rendering of words ceases. There is paralysis and aphasia.

In a third class of this same type, the process of change is more gradual. The fire burns lower, but does not die out. The man, advised by his physician and his friends, wisely retires from combat; he is too easily excited to bear it. Occasionally such a man finds out his peculiar constitution in time to save himself from immediate danger. He retires early from the public arena into a calmer sphere, and, by sufficient watchfulness, lives on for many and often useful years. As I write I recall an instance of this kind in a member of my own profession who discovered his danger early, gave up all thought of public conflict, and retired into a quiet medical practice, in which he was both active and successful. By this plan he lived on for over thirty years. Death came, however, at last suddenly, according to the rule so common in such examples.

In another set of these public men the saving of life is achieved to an extent, but not effectively. Life is prolonged, but healthy life is lost. The *vis nervosa* is no more. The need for change, for repose, for freedom from responsibility, is ever the necessity. The life is a penance for ambition, and is always short.

There are illustrations of another set of phenomena of disease incident to public men, in which the vital failure, springing originally from nervous injury, takes the course of a purely physical wasting malady. One disease of this character stands pre-eminently forward. I mean diabetes. I have myself had under my medical care at least six public men in whom this disease was clearly developed by some mental perturbation or nervous shock. In one of these instances the sufferer, for a short time a well-known and important officer of the State, had come into office at a period of extreme political strain. Solemnest issues were at stake, and momentous duties and decisions rested upon him, a man of moderate capacity, who, by pure industry and perseverance in a laborious profession had won an esteemed position, and who, just suiting the master then at the head of affairs, got into an office which he himself said was heavier than he could bear, and yet could not, with honour, leave. Called to question in the House on one of the responsibilities of the century, this statesman had a sense of faintness while speaking, and from that moment, under the mental strain or shock to which he was subjected, became diabetic, probably from some mechanical accident in his brain, involving the parts about the fourth ventricle. Thenceforward he died as straight off as a man can die from diabetic affection in its steadily progressive form.

The peril which is incurred by all political men in this country when they get a seat in the Commons, the peril of broken rest, has its forthcomings. Strong or weak, the members feel this risk, but not all equally. Some who are sufficiently fortunate to be able to turn day into night and night into day, and who are endowed with the faculty of sleeping at any time, get on very well, by their incessant labour astonish the world, and, unfortunately, often mislead their feebler brethren into attempts of a similar kind. But these are quite exceptional men. The majority, who are unable to give time for sleep in the day, sink into sleepless decrepitude; feel, at last, that they cannot sleep when the opportunity offers, and, depending on narcotics for a false repose, become, by a second nature, the slaves of a habit which has but one termination.

To the list of diseases above rendered as incident to active public life might be added those affections which we physicians call diathetic, and which are hereditary in those who suffer. It is possible that some diathetic diseases are brought out by the wear and tear of public work, but, then, they are also easily brought out by other and opposite influences, like gout when it is excited by luxury and too much rest. Setting one thing against another, I do not think that hereditary tendencies, with one grand exception, need trouble the would-be legislator.

But there is the one exception, which should never be left out of the reckoning, and that is insanity. The man who knows himself to be afflicted with that taint is doing his first insane act, while yet sane, when he throws himself into the struggles of a political career. This is no paradox; it is a truth which experience of men and of the proclivities of men teaches with a repetition that admits of no denial. The reasons of it are deducible from what has already been told.

To one standing aside and looking on at the political turmoil, it is marvellous that so much risk of life, vehemence of opinion, and utter uselessness of contention and labour should agitate the world. It can only be that political work is utterly wanting in all scientific accuracy that so many men so madly rush into it. Half-a-dozen great political scholars, working half-a-dozen months on a text-book of political science for the use of schools, might do more for the world, if their labours were accepted, than half-a-dozen parliaments, sitting out their full terms, and fighting each other from the beginning to the end of the chapter. Such fighting and killing, however, must be, until the long day when the truth dawns, that in matters where every one thinks he knows more than every one else, only a few know anything. But, while that day of light is dawning, let no one rashly believe that, in spite of all constitutional weaknesses, he can go on the political war path with safety, either to his physical or to his mental organization.

PHYSIOLOGICAL APTITUDES FOR POLITICAL LABOURS.

IN the essay immediately preceding, some of the dangers incidental to public life have been considered. How those dangers are encountered, and with what results, will turn on the aptitudes of the man who encounters them for the work he must face. These aptitudes, as based on constitutional primaries, it will be well to study in their natural position.

APTITUDES FOR PUBLIC LIFE.

Appetite, including the passions; emotion, including the sentiments; reason, including the true intellectual developments, as judgment or the weighing of evidence, knowledge or accumulation of observed phenomena, and wisdom or the balanced application of knowledge of all and various kinds;—these are the three vital primaries which enter into our present study. They constitute the three lives of man: A. The animal life. B. The emotional life. C. The intellectual life.

In every man these lives exist in varying physical proportions or quantities, according to organization; and, approximately, by their different quantities in different individuals, they divide the human family into seven distinctive and characteristic groups:—In the *first* group the appetites are dominant; in the *second* the emotions are dominant; in the *third* the intellect is dominant; in the *fourth* the appetites and emotions are dominant; in the *fifth* the appetites and intellect are dominant; in the *sixth* the emotions and intellect are dominant; in the *seventh* the appetites, emotions, and intellect are equally balanced, without any special domination.

In the physical construction of the body lies the cause of these distinctions of living faculty. The *animal life* is dependent on the peripheral or outlying surfaces of the body; on the surfaces of reception, the senses; on the surfaces of active motion, the muscles; on the surfaces of passive support, the solid parts which make up the skeleton; and on the whole of the great terminal, or, as I should prefer to call it, primary nervous expanse which receives and conducts impressions of motion from the outer world into the camera nervosa. The *emotional life* is dependent on the organic nervous centres, or ganglia, which lie within the visceral cavities of the body, and which, with their cords, constitute that great sympathetic chain of organic service which ministers to the heart, to the digestive system, to the secreting and excreting organs, and to all the involuntary, active organic mechanism which plays its part whether we will or no, and which, under extra impressions from without, often plays emotional acts or impulses we cannot control. The *intellectual life* is dependent on those storehouses of nervous motion which form the centres or masses of nervous matter; the brain, large and small, the medulla oblongata, the spinal cord, and the nervous trunks which constitute altogether the grand central voluntary system, the seat of our conscious directing, controlling selves, our reasoning soul.

From out of this physiological grouping of men we may, without much difficulty, and with considerable if not absolute precision, select those who are best fitted and those who are least fitted for the labours incident to a public career.

THE ANIMAL TYPE.

The men in whom the animal life is dominant are, in regard to mere labour, favourably placed. They are not, as a rule, long-lived men, but while they live they go through everything, through grief, through pain, through physical work, even through drink and debauchery, with exceptional facility. They fight like strong animals, sleep like animals, and eat and drink and enjoy pleasures like animals untamed as well as strong. Rise to eminence and distinction by mental capacity they cannot, but sometimes by the accidents incidental to endurance, and by waiting for the success which always comes to men who can wait long enough, they may get even a distinguished position, may eclipse more gifted compeers, and, under the credit of being thoroughly English and trustworthy, rough but diamond-like, blunt but honest, or some similar description, may become, in a sense, powerful. Particularly happy are they if, by a touch of humour, by a joke, or by a fulmination that is not too severe, they can make themselves understood. Then they are sure to have a host of followers of their own tastes, whose animal force goes for two to one of any other captivated admirers of powerful men.

I have in my mind at this time a man, once well known, of this really political prize-fighting type, a famous man to whom the masses, with an expectation of hearing something striking, would listen with an eagerness which rarely was disappointed, and with cheers on their parts, such as the old Romans would have bestowed on a gladiator. By members of elevated intellectual society this type of man is not accounted of much worth; he cannot be, according to the standard of his critics, because he is not of their nature. But he lives through clamours and riots in which they would speedily perish. His emotional and intellectual faculties are the servants of his appetites, and are so controlled by them as to protect to the utmost his nervous organization from the fatal exhaustion which in higher natures would, inevitably, be induced.

When a man of this animal class dies in harness, it is not, usually, from public labour, but rather from some animal disease begotten often of animal propensities; disease which would have come on if he had led a life of leisure, and would, in all likelihood, have come on sooner in the luxury of leisure than in the field of combat.

The Emotional Type.

The men of the second class, the men in whom the emotional nature is dominant, are neither for their own sakes nor their country's sakes good representatives of public life. They are, nevertheless, often ardent politicians, particularly when out of Parliament. Led by impulses which appeal to natures like their own, they are usually responded to with a rapidity of response which leads them to the belief that their work or their cause must not only be right, but must be carried without a moment's loss of time. They constantly lead with them, in their political furor, whole armies of the gentler sex, by whom they are often much admired. It is not uncommon that they win triumphantly, what to the colder intellectual mind is mere sound, and what becomes, in a short course of time, worthless, neglected, and forgotten by those who first commended it.

The emotional politician commonly loses his balance, be he successful or unsuccessful; he becomes sleepless; grows, like Cassius, aweary of the world, and, failing from the heart, dies a long death, sensitively conscious to the last of his own failures, and sinking under them without hope of revival.

The Intellectual Type.

The man of the third class, in whom the reasoning powers are dominant, the animal qualities moderate, the emotional subdued, is one well fitted for public life. He is not a giant. He cannot be rough, for he has no animal rudeness; he cannot be sympathetic, passionate, or emotional, for he has no active excitable centres of emotion; but he can reason well, can judge of men and things calmly; can wait for the progress of events; can put forth what power he possesses when the opportunity occurs, and by cold methodic art carve his way to fame. Such a man is like steel,—polished, cutting, irresistible. His thoughts are sharp points, his sayings epigrams. In the wars of parties he lives long and, up to his desire of happiness, happily. The work hurts him not, neither by its penalties of contests nor by its pleasures. He can even accept honours and so-called dignities of any degree without injuring others, and, better still, without injury to himself.

The Emotional Animal Type.

The man of the fourth division, in whom the emotional nature is blended with the strong animal, is even more indifferently formed for political life than the mere emotional man. He is in truth more or less of a savage, possessing all the proclivities of one, tempered, and no more, by surrounding civilization. He is ambitious for the political strife because he sees in the field of politics an opening for much that is tempting to his animal cravings and his emotional delights. He is as urgent, but not as strong as his more animal compeer, for his animal nature, easily frightened by his emotional, is led to do violent things and say violent sayings, which, after they have made a tremendous stir, he is often glad to apologise for or withdraw. At periods of his career he may carry with him as much success as the mere emotionalist; but, led away by his animal instincts, he is given to desert his friends and his principles for his own gratifications; then he is said to have become a turncoat, to have ratted, or to have sacrificed his principles to his interests or his pleasures, and down he goes. Such men carry the same propensities into their social life. Loving strongly and hating strongly, with capricious taste, they get into social scrapes from which it is not easy to find escape. In the end, and the end often is very rapid, they break down physically, take to drinking or narcotic indulgence as a living shroud, and in the prime of life, measured by mere years of life, drop out of it as if ashamed to live.

THE INTELLECTUAL ANIMAL TYPE.

In the fifth class of man, in whom the animal combines with the intellectual, we have the type of him who of all others is best fitted for a public career, and who, taking part in such career heartily, carries himself with a triumphant persistency that becomes the wonder of foes and friends alike throughout the world. In this man, with the strong animal nature happily blended with the strong intellectual and a low or suppressed emotional nature, and with the potent animal qualities controlled and kept within reasonable bounds by the intellectual, we have the typical giant of public political life. His very animality quickens his intellectuality, while the diversions of one of his natures acts as the foil for the other. Such a man, usually spare but largely framed, in so far as his skeleton is concerned, has all the organs of his body in full activity. He above all others is the man to weather public opinion. People say, in the vulgar tongue, of such as he, "he is without bowels," *i.e.*, without sympathies, and the saying is about as true as any words of science could invent and adopt to convey the truth.

THE EMOTIONAL INTELLECTUAL TYPE.

The man of the sixth class, in whom the emotional and intellectual natures combine, but in whom the animal qualities are feeble, does very little except supply ornament to the political sphere. He is said to be bright and good. He lends a hand to assist the arts and all that renders existence delightful. He is courted, not trusted. He has feeling without action, wisdom without promptitude. He sympathises, he philosophises, and therewith begins and ends his services to his species. Everybody, who can, asks him to dinner or to the evening party. The societies and academies run after him pell-mell. The philanthropists lie in wait for him, and the poets and men of letters rejoice in gaining his esteem. He sometimes commits himself to the dilettante; is a poet in a small way; a painter; a dabbler in science; or a polemic. Three chances to one he is an antiquarian, and he is a splendid patron, whatever else he may be. In politics he often makes a good figure head.

THE EQUALLY BALANCED TYPE.

The last man on our list, he in whom the animal, the emotional, and the intellectual qualities are equally blended, might, one would think, be the model statesman. He is well fitted for public life, and in it rarely fails to become a good and useful public servant. He is a trusted man, and whenever the opportunity offers is looked upon with respect by opponents as well as friends. But he creates little enthusiasm, and perhaps is never fully accepted as a leader. Peel came near to the balance of qualities, but with a little excess of emotion. I once heard George Coombe say that Burke had the most perfectly balanced nature; but Coombe was led to this conclusion by the beautiful proportions of the head of the statesman, not by his nature as a whole. No doubt, however, Burke, intense in all qualities, came near the standard. He could guide strong emotion by intellect, and support both emotion and intellect by animal vigour.

Of these seven types of public men, the emotional, the animal emotional, and the intellectual emotional, ought for their own sakes to be out of the strife; and, for the country's sake, the animal were also well out. As it is, all are in now, with the four least apt most likely to go in most abundantly, *until* the national intellect and physique shall grow healthier and more vigorous, and until emotion, most useful and humanizing when not dominant, shall find its true place.

UNDER LONDON. A PROJECT FOR RADICAL RECONSTRUCTION.

IN the first volume of THE ASCLEPIAD I suggested the construction of a new and upper London, with terraces and gardens overhead, and pleasant walks and a smokeless canopy. The project, to which Mr. Westgarth has, in more than one paper, given his powerful commendation, has taken well with large numbers of the community, and many an inquiry is made of me when the pleasant and, as most people admit, easy reform is about to be set on foot. I answer always, *wait*, and little by little it is sure not only to be commenced, but to be carried out to the fullest extent. For the day is not far distant when, from sheer necessity, traffic through the streets of London must be relieved by the introduction of some new project; and, when that necessity has to come under discussion, then the Upper-London project will naturally force, and probably soon win, its way.

While that is in the balance, there lies before us another, and, indeed, more pressing need, having relation to the London under the feet of Londoners, and having reference to the regular and effective removal of the most dangerous refuse of the household, and the utilization of that refuse for the benefit of the human family.

What millions of money have been spent in the effort to purify Under London we all know. What have been the results of that expenditure,—not to use the word success,—few know. Some of us, of the Society of Arts, at the instance of Mr. Edwin Chadwick, whose name as a sanitarian is a name of the century, did, some time ago, commence an inquiry bearing upon the important point now under consideration. We opened, or, more correctly speaking, we re-opened, the question practically, and we discerned all at once,—although our inquiries were entirely confined to limited areas of London,—so much evil, that we rather abruptly closed the evil up again, as if we were frightened at it; a weak action, for sewage, like murder, will out, and enquiry must proceed.

What we did discover was in truth so serious, that the wonder we laboured under was how London can be so healthy as it is. We found that London is still honeycombed with what are not in name cesspools, but are, in fact, sewers of deposit; a truth we all practically recognise by the second-hand measures we take to meet the primary blunder. For example. From the window at which these remarks are written, I see that one of my neighbours, the owner of a large house, has carried out of his house, from the basement, a three-inch tube far above the level of the parapet, in order to deliver into the air any gases that may accumulate in the main drain of his residence.

It is not good for the air which I and many others have to live upon, that it should receive the foul air from the decomposition of my neighbour's organic excreta; and if everybody's neighbours did what he has done, it would be detected, in some weathers, that the process must be stopped, as it was in a former day on a recommendation of the Royal College of Physicians. I do not, however, blame my neighbour for what he has done, because I have done it myself. It is a natural method of self-protection amongst those who know best how to protect themselves. The contention is, that the necessity for any such method is proof demonstrative of the rottenness of the primary system which causes the necessity, and which keeping us foul beneath our houses, makes the air, at its best, foul also above them. The contention is that the decomposition which gives origin to the gases that are let out by thousands upon thousands of channels, by tubes from houses, by soil-pipes within houses, by accidental openings and pores in all directions, by gullies in streets, and by great outlets of sewers from accumulations of sewage, ought never to have been permitted at all. The contention is that the sewage, removed clean away, unintermittingly, many miles from the community, without having decomposed either above or below the living-place, need never pollute any place nor have any destination except the land which is calling for it and which dies if its demands be not naturally supplied.

The complete removal, at every moment, of all the organic excreta is, however, still an unsolved difficulty, which, remaining unsolved, is a block to every step towards perfect purification.

Combined and Separate Sewerage.

We are yet distracted with the debate ever going on between the advocates of the combined and the separate system of drainage. Shall all our organic excreta go with the storm water into the river and sea, or shall the water go to the river and sea, the sewage to the land? Unlike our neighbours on the other side of the Channel, we have agreed to give up the cesspool, and have not agreed as they have, that all disposal of sewage in running streams shall be legally prohibited. But, in giving up the cesspool, have we greatly advanced, so long as we pollute the running stream and lose the natural fertilizer of the land? Looking back on all the controversy for the last thirty years, and reading back still further, I feel we have not advanced. I do not think it would be wise to return to the most scientific system of cesspoolage, but I cannot conceive any next worse plan than the plan of passing the sewage with storm-water, even on the most scientific system, into running streams, and of robbing the land of its greatest requirement.

The Combined Failure.

In London the combined system having obtained most favour, and the people having without stint poured their wealth, as well as their sewage into it, the system has had its best days and its best chances. Everything has been said and done for it that could be said and done for it. Time has been given to the trial of it with a patience unexampled. The advocates of it, the sustainers of it,—and let all credit be given to them in these respects,—have laboured for it with a perseverance, a skill, and an enthusiasm worthy of a dozen better causes. But what has been their success? Let the great Outfall failure tell its own story. It will be most interesting at the close of this year to see what has been the expense for outside deodorization, alone, in twelve months. What has been the cost for the material alone of the thousands upon thousands of tons of so-called disinfectants poured out to purify what ought never to have demanded purification! Mr. Chadwick says £200,000; and every penny of this cost a penny's worth of proof of the radical mistake which has been committed, and which, by the natural force of example, has been extended from the metropolis into other great centres.

Since the gigantic difficulties in respect to the great outfall, the pollution of the river at the outfall, and the loss of the most valuable product which London produces, have become fully recognized truths, the people generally are asking what is to be done. Then comes the scare of approaching cholera, and loud outcry and busy fussation of tentative schemes, and serious complaints of heavy tentative expenditures, with a happy subsidence of the scare, followed by an unhappy subsidence of complaint. A period, in short, of waiting for another scare, and of waiting longer still for the verification of the *bona fides* of the scare in a grand epidemic and a hasty resolution, thereupon, to make some change for better or for worse.

The true sanitarian does not acknowledge the soundness of this principle of waiting to be forced to do. He wishes the best thing to be done at the best time, that is to say, at the time when the mind of the community is free from all excitement, and when the mind of men of science is open to work without pressure, and with the feeling of perfect freedom from all haste and worry. The work that is required to be done should be done now while there is pause; and it should be done so effectively, that it will not require to be recast for a century at least, unless some new and radical discovery should be advanced that will provide a radically better principle and practice. If our engineers had kept to their own splendid department of science, instead of assuming the position of doctors of health, or if the latter had been stauncher at the first, all the present trouble might have been saved. By reverting to their true positions and functions, both can make a magnificent amende.

The Work to be Done.

What it is requisite now to do for Under London is so obvious, and, in fact, so simple, that it may be told in a few minutes. If I am correct, moreover, in what I have learned, the prime cost of the doing would be comparatively small, while the returns would rapidly repay all the original outlay.

The first thing to be done is to come direct to the natural and only common-sense principle, the separate system of disposal of the sewage. "*The sewage to the land, the storm water to the river,*" is a proverb which every boy and girl at school should learn, and every man and woman who has influence should enforce. It is the basis of all true and safe sanitation. It is obviously the method of nature herself, when she is left to her own devices; and where could we find a better teacher? If, indeed, her scheme for this purpose were not so grand that our worst ignorances cannot thwart it, all vital motion on the earth would cease, for it is her plan, out of the very womb of death to bring forth the most perfect forms of life. She builds up the earth and all that is earthy by primary burial of the earthy; she vitalizes by the living waters moved by the sun and the moon. Were she to drop all her treasures into the sea, as some of her children do, there would soon be no land on which things of life could live.

We Londoners, therefore, must, if we would do the best thing in the best way and for the best purpose, follow our mistress and guide in her mighty cleansings of the dead matter from the living.

When we have once got this principle in our minds and are brought to the application, we may look at what it is we have got already, before we determine what it is we have to change. Fortunately, we may discover by this inquiry that what we have got, faulty as it is, admits of being utilized, to which utilization we should direct all our efforts.

A system of sewers within the present sewers is the project we ought to insist on; of sewers limited and perfect for conveying from every house its own sewage together with the water used in the house for its own purposes,—no more, no less.

And for the storm water a system for its escape as storm water into the river through the existing channels, outside the true sewers, and absolutely separate and distinct from them.

Towards the attainment of this object there is no difficulty that cannot be overcome. All is laid out for the work. Whether the inner sewers should run along the floors of the existing sewers, or be raised above those floors, or be suspended from their roofs, is a point of detail that may have to be studied and experimented on in order to prove which position is most convenient. This detail does not affect the method.

The material for the construction of the inner or true sewer might probably be settled on at once, because on this matter there is experience for a guide. In some American cities, and in some English places, iron tubes are found effective, and nothing could be better here. Such tubes are already constructed for conveyance of water and coal gas; they can be perfectly closed throughout, so that no sewer gas need escape from them, and they can most readily be made to communicate with the main drain of each house.

The size of the true sewer may be a subject for consideration, but the question can easily be solved from existing data. My own view would be for small sewers, a four-inch drain for a house of twenty rooms, and the sewer in proportion, as Mr. Chadwick has suggested, and planned according to the shape which he also has described so convincingly.

Taken systematically from one district to another, London might, in this manner, be sewered throughout, without the change being known by the masses of its great community. There need be no opening of streets to lay down new lines of sewers, no important stoppages of existing outflows from the houses. As the inner sewers were laid down within the existing ones, the connection from house to house could be laid until all was complete. Moreover, the connection between one house and another, now so very imperfect, could, during the change, be rendered absolutely perfect.

As a method of conveyance of the sewage of every house, away to some common escape from the town or city altogether, this plan admits of the application of yet another advantage. By the addition of an exhaust pumping system at various sumps or stations for bringing the sewage freely and regularly out of the houses from which it flows and on to its final destinations, the houses themselves, ventilated with the best obtainable outside air, might have the air carried away through every outlet from them into the central sewer. The water closet, instead of being charged with the emanations from the closet, would be flooded with air from without, which air would flow down the closet, and away by the main drain, as the water from the closet flows into the drain. The same with the sinks and every other of the openings, where there is an exit for the contents from the dwelling. The bad air from slums, mews, shambles, vegetable markets, dust bins, and all repositories of objectionable matters, solid, fluid, aerial, could also be carried off by properly constructed communications through the exhausting central sewer.

THE DESTINATION OF THE SEWAGE.

It will, I doubt not, be admitted freely that the attainment of such a system as is above contemplated would be a result satisfactory beyond expectation. But what, it will be asked, is to be the destination of the sewage flowing through the central sewer, and what of the storm water flowing by it, but unmixed with it?

Let us take the disposal of the sewage first, as the most important and difficult question.

It will be seen at once that the enormous difficulties at present existing would be exceedingly reduced under the system above proposed, by two changes,—the tremendous reduction in the volume of material that has to be disposed of, and the condensed character of the sewerage itself. We should be dealing, not with diluted decomposing material, but with a substance undecomposed and ready for application, as required for purposes of cultivation. This reduction in volume, which might be still further promoted by a reduction of the water supply to the extent of ninety million of gallons per day, would render the fluid manageable both for collection and transportation.

The plan I suggest for direct disposal of the separated fluid is that there should be constructed at, or near to, the present outfall, or at any better place on the river, a series of vast covered docks or reservoirs, into which the fluid from the prime sewer should be pumped, and in which it should be retained for brief periods until its removal. To effect removal from the reservoirs, I should suggest floating barges or tanks which, loaded with the product, should steam away with it and carry it wherever it was destined to be borne, to the sea, if it must needs be thrown adrift, to some point of land for utilization.

Whenever it was made known that material of such value for the land, as the contents of these floating galleons of wealth, was in the market, we cannot but suppose that the demand for it would be instant. There are men living who can remember the time when the Bristol barrel filled with the same kind of product went from the Belgravian fields to the West Indies, and—tell it not in our sanitarian Gath—came back loaded with the same product transmuted, in the laboratory of nature, into sugar! Why not in a better form, in these better days, transmit the same kind of substance to different parts of the earth, or to barren portions of our own islands, and there let nature transmute it into fruit, sugar, or other useful substance, in such a way that it could administer its full benefits to mankind? Barren portions of our sea-coasts could, by these modifications of the separate system, be made the most fertile and beautiful of all our tracts of vegetation.

To the engineer, when once a system were decided on and declared, these modes of transit, with many improvements, would speedily occur. With the engineers it is not my province to interfere. They exist to carry out what has been determined on, and when they know what the people want, they will do what is wanted, as surely as they will lay down, after the country has said they must, a new railway or a telegraph. We have but to declare the principle, and get it declared, that every town in England must be cleansed of its organic excreta out and out, day by day, as certainly as it is supplied with the food brought into it, and the thing were done.

Toward such perfection any powerful movement steadily and resolutely devoting itself, would soon be backed up by the common sense of the people, who require nothing more than a competent authority to settle the subject accurately. The utter failure of the combined system as a permanent solution of the drainage difficulty, and as a mere transition from the cesspool to the method of separate removal with immediate and fruitful utilisation, is becoming apparent with such swift conviction, that it will soon bring an outcry, unless, irrespective of all interests except the true ones, existing authorities will undertake the necessary radical reformation.

The moment we can, by the skill of our engineers, get our in and out going drainage system as good as our railway system, as true in its working, as continuous and systematic, the most important of all our basic sanitary reforms will have been introduced. Without any stretch of the imagination, volumes might be written on the affirmative side of this proposition; they would only prove from collected experience and observation that until this basic reform is carried out there can be no sound sanitation at all. I have asked many times, sought many times, for so much as one instance in which the combined system of sewerage apart altogether from its loss and extravagance,—which might be tolerated if its results were good—has proved a sanitary success. I can find no instance of the kind.

The towns which depend, as London does, on storm water to flush and inundate their sewers, are like the old mariners who depended on favourable weather for a favourable voyage. The day has passed for that process.

The last difficulty that has to be met relates to the disposal of the storm water, and that is solved, or may be solved, in the one sentence, "*the water to the river.*" In some places, where the river is small it might be well to let the proverb have its full play; in London it might or might not, for the Thames is large enough either to receive the storm water or to do without it. In London, consequently, we might catch the storm water, if that were desirable, in separate reservoirs situated in different parts, and use it for laundry work and many other valuable purposes.

Thus on all sides the advantage of the separate system would turn to good account in the mighty Babylon which we have reared to-day. By it, Babylon, in its worst quarters, would be ventilated; Babylon would at every minute of its life be scoured, cleansed, and purged; Babylon would send forth its dead and dangerous refuse for living and useful purposes; and Babylon would insure to itself good and pure water, for that cleanliness which is next to godliness, and without which godliness itself were a rare virtue.

Upper London a garden of terraces and flowers, beneath a smokeless canopy. Under London a double river, one of dead wealth, the other of living water. This would indeed be London.

ANTONY VAN LEEUWENHOEK, F.R.S., AND THE ORIGIN OF HISTOLOGY.

EPICTETUS, descanting on those men of the historic world who bear the lights by which the world is illuminated, divided them into two classes; those who carry a torch, and those who carry a lantern. The torch-bearers are the widely-known men of their era; their light lighteth them. Everything that they do is rendered obvious to the commonest sight. Their very features are distinctively learned off, so that they are recognizable, personally, by multitudes who have never seen them in the flesh. They are, as living men, the bye words and party words of their generation and a few of them live, but most go out with their torches. Nay, the torch often drops with the bearer of it, before the bearer of it is dead.

The lantern-bearers, less conspicuous, retain their light, usually, to the close of the chapter, and often leave it so that it keeps aglow for others to take their light from it, and extend their radiant glory.

Of the lantern-bearers of science few are more representative than the great Dutchman Antony Van Leeuwenhoek, pronounced in English fashion Leuvenhock, a man who lived ninety-one years, who worked industriously for seventy years of that period at least, carrying his lantern, a very good one, and his light, a very useful and clear one, all the while. A man of whom it cannot be said that he was either unrecognized or slighted, since the two greatest societies of the world conferred on him their honours, and one of the greatest Cæsars who ever cæsared paid him a visit in order to inspect some of his scientific work; but who, for all that, was, personally, so little known that the biographer looks round in despair, at first sight, as he searches for material.

Antony Van Leeuwenhoek had no troops of ordinary friends, none of deadly enemies, to proclaim his fame, as William Harvey had; no hosts of pupils to spread his name the world over, as Boerhaave had; no worshipping, idolatrous Boswell, to catch up all his sayings and doings, as Samuel Johnson had; no museum to carry down the substantial record of his labours as John and William Hunter had; no Alexander Pope to immortalize him in verse, as Arbuthnot had; no relative to write down his history, as Aitken and Hope had; no hand, no mind to write his own life and labour, like Goethe, Franklin, and Priestley.

Above all things, strange is it that Samuel Hoole, who collected and translated the works of Leeuwenhoek into English, reproducing within two handsome volumes the plates with which his author illustrated his papers, did not strive in his day, when there must have been persons living to whom his author was known, did not strive to collect any biographical details, but was content in that direction to introduce the portrait of him which re-appears in this Asclepiad.

What we know of Leeuwenhoek personally is all connected with one town in Holland, eight miles or so from Rotterdam, the town of Delft.

Between the years 1632 and 1723, the period of Leeuwenhoek's career, Delft was an ancient but flourishing commercial and military place, possessing a remarkable history. It was then, as it still remains, intersected by canals; in its centre a market-place, like an artificial island, and over its canals a number of stone bridges, connecting the various sections of the place with the centre. In this town the people of the Low Countries cast their weapons of war—Van Tromp's cannon most likely—and kept their fighting stores; and here, when Leeuwenhoek was twenty-two years of age, occurred the great catastrophe of the explosion of an immense powder magazine by which every house in the place was more or less injured, and many people were wounded and killed. In the Prinzen Hof of the town, in a previous time, the first William of Orange had once lived, and it was in this Hof that he was assassinated.

In this old centre of Dutchman's wealth and power our man Antony was born on October 24th, 1632. William Harvey, then fifty-four years of age, had by this date established his discovery of the circulation of the blood; and Gaspar d'Aselli, then fifty-one years of age, had made his discovery but had not induced his cotemporaries, not even Harvey himself, as one of them, to recognise it, of the lacteal vessels and their function as carriers of the chyle. I name Leeuwenhoek thus early with these two illustrious men because, as we shall see in the sequel, he, by another discovery, crowned their remarkable researches, and completed the discovery of the circulation.

BEDELLUS IMMORTALIS.

For the reason that Leeuwenhoek was, as a physiologist, akin to two great medical scholars, I claim for him in these pages a place amongst the illustrious who have made great the healing art, and have introduced an instauration into the science of healing. At the same time I must destroy the illusion which Wunderbeck started, to the effect that he, Leeuwenhoek, was a physician in practice at Delft. Antony Van Leeuwenhoek was neither bred to physic nor, except in the most casual and informal way, was he a practitioner of it. His own works prove this fact to the letter. Towards medicine as a practical art, and specially towards it as a practical science, he was a sceptic, and one who appears to have enjoyed many a sly joke at the expense of the faculty. Thus, at the close of his research on digestion, he apologizes for having touched a medical subject. "Some," he says, "will think that I am going out of my province, but these considerations weigh very little with me, forasmuch as every judicious person knows that physicians themselves in many things proceed merely by guess, and, therefore, I assume to myself the liberty of offering my suggestions on the subject."

But although not a regular professor of medicine by an orthodox system of training, by a diploma or a degree, he was, like Stephen Hales, J. B. Reade, and the late George Lewis, learned in physic. His whole soul was absorbed in the study of natural history, and its relationship to the medical side of that history. Every line he writes bearing on this department shows that he was, for his time, a remarkable anatomist. In describing structures generally he exhibited a precision which was equal to that of any of his medical cotemporaries, and when he entered into new researches on which he had the earliest views or glimpses he stood pre-eminently first and foremost.

About his parentage, his education, his manner of making his living, we of England, and the same, I think, may be said of French and German authorities, have had nothing more than conjecture to go upon until the present date. The truly distinguished writer on Leeuwenhoek in the *Encyclopædia Britannica*—Dr. W. B. Carpenter—sustains the hypothesis that he was an optician, or a manufacturer of lenses; to which view I was attached also until, on reading his works more carefully, I gained from them certain internal proof that the conjecture was all wrong. I was then led to the conclusion that he was occupied as a treasurer or comptroller, or as one who was engaged in some pursuit in which arithmetical labours formed a chief part. Happily now the difficulty has been set at rest by my diligent and learned friend, Mr. A. Wynter-Blyth, who, having, while writing his admirable work on poisons, found out that Leeuwenhoek discovered the alkaloids theine and pipereine, felt so much interest in him as to look up his life and career from original Dutch sources, and alighted on the truth. I am indebted to my friend for the following valuable epitome of the leading facts of the personal life of our philosopher.

"Antony Van Leeuwenhoek was derived from a good Delft family, his mother being daughter of Jacob Sebastiaanzn Bel van den Bergh, who, in 1608, was a member of the municipality, and, in 1610, was sheriff. Through this family he was related to the Hogenboeks, Bleiswijks, Swalmius, and Malthenesses. His grandfather and great-grandfather were Delft brewers, and his grandmother a brewer's daughter. They were probably rich, and, as the Dutch poet, Jacob van der Does, has it,

"'Their pillows through malt were stuffed with gold.'

On the death of Philip Antony Van Leeuwenhoek, his father, his mother, who was left with the young Antony and his three sisters, Margaret, Gertrude, and Catherine, sent the little boy to a school at Warmond, from whence he was transferred to Benthuizen, under the care of an uncle, who held an official appointment at that time. He learnt, in both places, the ordinary elements, and seems from his writings to have acquired a fair knowledge of mathematics. We may presume that it was intended he should follow his uncle's occupation; but from some reason or other this did not come to pass. In 1648, when he was sixteen years old, he was removed to a clothier's business in Amsterdam, where he filled the offices of book-keeper and cashier. The time he remained at Amsterdam is uncertain, but it could only have been a few years, for at the age of twenty-two he returned to Delft and married.

"Six years after his marriage he obtained an appointment at Delft, styled chamberlain of the sheriff. The duties of the office are clearly set forth in his commission, a document still extant. They were: 'To open and shut the door of the chamber, both on ordinary and extraordinary days of meeting. To show honour and respect to the councillors; to keep inviolate anything he might hear in the council chamber; to keep the chamber clean; to make the fires; also to preserve the place from fire, and to do all that a good and faithful chamberlain should do.'

"Whatever the title of the office might be, the duties were evidently those of a Beadle. No doubt he did and could set meaner hands to do the scrubbing and sweeping, but the fact remains that, as the Scots made their greatest poet an exciseman, so the Dutch made their philosopher a beadle. The salary was small, about £26 a year. He held the post for thirty-nine years, and the salary was paid to him until his death."

The account thus offered by Mr. A. Wynter-Blyth tallies well with all that is conveyed to us by the writings and works of Leeuwenhoek. I had written before I knew these curious and interesting details the following passages:—Whatever the pursuits were, probably those of a treasurer or comptroller, by which Leeuwenhoek subsisted, they afforded him leisure for abundant means of original investigation, and for carrying his philosopher's lantern in an easy mood to a truly patriarchal period of life. That he was in comfortable, if not in affluent, circumstances is clear from the character of his writings; that he was not troubled by any very anxious and responsible duties is certain from the continuity of his scientific labours and from the independent cheerfulness of his sayings, which gives them a charm equal to the delight of the teeming novelties with which they are pervaded; that he was always at home and performing some regular duties which held him closely is most obvious from his descriptions; that he possessed the respect of all persons, great and small, is equally clear; that he could secure the services of persons of influence is discernible from the circumstances, that in 1673 De Graaf sent his first paper to our Royal Society; that in 1680 the same Society admitted him a fellow, that the Directors of the East India Company sent him specimens of natural history, and that, in 1698, Peter the Great paid him a call to inspect his microscopes and their revelations.

Lastly, that he was a man in some subordinate office connected either with the municipality of Delft or with some great business there is as certain as all the rest —is, in truth, almost as plainly indicated in his letters and comments as if he had told us so in as many words.

From the facts now in our possession, then, Antony Van Leeuwenhoek, as a man of mere flesh and blood, stands fairly before us, earning his livelihood in about as simple a way as it could be earned, and following up his scientific discoveries as a pure pleasure resting upon an almost sacred gift for work and a command to communicate it. To his immediate friends and equals he would be an oddity much as our own Stephen Gray, who invented the first electric line, was to his. Who would think, indeed, that one who was deputed to open and shut the door of the council chamber, and show honour and respect to the councillors of the little town of Delft, would in after-days have such a name that learned men of other nations should make it a point of scholarship to find out what he did for a living? Truly it is a wise ordination that the greatest of the earth should be blind to their own immortality. They might go insane and lose it all were they not in this manner protected from the lust of self-adulation.

What appearance the Bedellus presented to his fellow-townsmen is shown in the portrait of him by the painter I. Verkolje, in the year 1695. He, the Bedellus, was then in his midday fame, still healthy and strong, and distinguished as "Antonius A. Leeuwenhoek, Delphensis, R.S.S. Æt. LXIII. MDCCXCV." I have another copy of the same portrait in my edition of Hoole, engraved in or about the year 1800 by Anker Smith, an Associate of our own

Royal Academy. Smith's engraving is more finished than the one by A. de Blois here reproduced, but does not offer so robust an expression and character. As we study the portrait, we see at once a mixed racial type. The Semitic and Teutonic races combine as equally in the look of the man as in his work. A Jewish Saxon, of all organizations for industrious, solid, original, and wise work, the best of best; obstinate and yet imaginative; its very obstinacy a virtue, saving it from flying too far wild by its imagination, and preventing it from running after or envying other men's labours, or caring much for any labours except its own. In the face peering through the big wig, there is the quiet force of Cromwell, with the delicate disdain of Spinoza. A deep, soft voice accompanied, I warrant, that look, and a sly humour, which made the councillors themselves nervous without giving them occasion for anger or offence. A broad forehead; full dark eye; thick-set nose; thick lips with small moustache, according to the fashion of the time; a round, closely-shaven chin; and, a short veritable bull-neck, well concealed by the loose kerchief, worn as Isaac Newton wore his, the most graceful, surely, of all kerchiefs ever worn since that article of attire came into use.

Mr. Blyth tells me there are extant other portraits of our Bedellus, namely, an oil-portrait in the possession of Dr. Kaatthoven, of Leyden—date and painter unknown—and engraved in 1875 by P. J. Haaxman; a profile, struck on a silver medal in 1716, when the subject of it was in his eighty-fourth year; some plaques of Delft ware; and, a bust in that old Reformed church of Delft in which the remains of the Bedellus were entombed. The portrait belonging to Dr. Kaathoven represents, Mr. Blyth considers, "the great man in his prime, grave and thoughtful, his features regular, forehead large, brows bushy and arched, nose rather thick, lips well-formed, shaven chin pronounced and full, long wavy tresses of the wig falling on the shoulders, neck enveloped in loose, easy neckcloth, with the ends hanging down over the chest, and dress a kind of silken robe or dressing-gown. He is presented seated at a table with compasses held in his right hand, as if he had just been drawing a mathematical figure; and on the table is a globe and the diploma of the Royal Society. In the profile, on the silver medal, his face is clean shaven, is thinner, sharper, and more wrinkled, with the cheeks hollow, as if he had lost most of his teeth."

I trust now that we have, in our mind's eye, a fair knowledge of the unique Bedellus of Delft as he lived and moved in the sphere in which he learned and laboured truly to get his own living. If, as strangers, we had been introduced to him in the streets, on the bridges, or in the squares of Delft, we should, I doubt not, have been struck with his manner, conversation, and general knowledge of all things and all men. We should have heard of the great people who had been to see him, the professors from Leyden, Boerhaave, and Bidloo; the philosopher Huygens; and the mighty Peter, Czar of all the Russias. We should detect that everybody he could reach, from Captain Isaac van Krimpen, who brought him the eye of a whale, to the glass blower who came to the fair at Delft, and to the little domestic servant who caught fleas for him, taking care not to injure them by pressure and keeping them for him in a glass tube, was sure to be impressed into his service. We should see strange proofs of his mechanical skill; of the new sight which he had invented, and the curious objects hitherto concealed from mortal eye, which he had seen and let others see. We should hear the pride of Delft expressing itself, of the great foreign fame of this native of Delft, and of the astounding honours which England and France had bestowed on him, the Dutch Bedellus.

This fate, perhaps fortunately, is not ours; but it is ours to look at the Bedellus, whom we now know, by another study; by his long-enduring merit through his works which have given him his endurance. Let us then turn to him in this new light. Let Bedellus, passing away as such, henceforth appear in some of his well-earned immortality as a leader of science.

THE MAN OF MANY LETTERS.

Like Samuel Richardson, Antony Van Leeuwenhoek was a man of many letters. All, or nearly all that he did in the literary way was after the manner of an epistle. He wrote his epistles from nature, and sent them to the best commentators he knew of for commentation, publication, and circulation.

The French Academy of Sciences, of which he was elected corresponding member in 1697, got twenty-six; but the lion's share fell to our young Royal Society, which, in fifty years—namely, from 1673, when Dr. Regnerus de Graaf communicated a first paper, entitled "*A specimen of some observations made by a microscope contrived by M. Leeuwenhoek in Holland*," to 1723, the year of Van Leeuwenhoek's death—received from him for its archives three hundred and seventy-five letters and papers. The subjects of research are most varied. Hoole's selection contains references to over one hundred and fifty topics in natural history, on which his master had cast thought and light, and Hoole

Name of Paper sent by Gra (

omitted, apparently from what he considered delicacy, all reference to his author's researches on generation and other allied subjects.

The works themselves, except that they lie in the domain of natural history, are disconnected, and appear in no order of systematized study. The philosopher was led by what transpired at any moment to lead him.

We find, therefore, in the letters a natural incongruity, but atoned for by a rich fulness of interest, wherever the details may be tackled, that almost defies any natural scholar to begin a theme and not study through the whole. The difficulty, indeed, is in beginning to read, and the reason, I think, why Leeuwenhoek is so little understood rests on this difficulty. For a considerable sum I bought two volumes of Leeuwenhoek, finely illustrated, not long since. The volumes were eighty-five years old, and not a page cut.

As we read through the works we see that their originator copied from no authority whatever, except from nature. He may be right, he may be wrong in his statements, but whoever criticises him must go to the prime authority, his authority, for the criticism. This probably was an unintentional cause of offence to some of his cotemporaries, and it has been so to many who have followed. This also led him, equally unintentionally, to cross other men's paths with original observations which were not absolutely original. So he crossed our own brilliant and petulant philosopher Robert Hooke, author of the "Micrographia," a cotemporary of his, but he did not mean to do it.

THE WORKS BRIEFLY CLASSIFIED.

I have spoken of the variety of the work, and more I scarcely dare to speak, lest I should be carried too far into description. I must, therefore, be content to name briefly the greater subjects in this place, securing a larger space for one or two of them later on.

Animals of Different Kinds.

Animalcules or microscopic animals; the ant; cantharides; cochineal as an animal product; fish, a number of curious notes on, with special reference to the herring; the eel; the flea; the fly; the frog; the fluke of sheep; the gnat; the locust; the louse; the maggot; the millipeda indica; the mite; the sea and fresh-water muscle; the scorpion; the shrimp; the silkworm; the snail; the spider; the tadpole; the viper, and its poison; the weevil, or corn beetle; the whale.

Plants, Vegetables, and their Products.

The ash tree; the bark of trees; the beech; boxwood; the cocoa tree and cocoa nut; coffee; corn in granaries; cotton; ebony wood; elm timber; excrescences on leaves of oak, producing the gall nut; excrescences on thistles and willow leaves; fir timber; the gall nut; the hop; the lime tree; mace; the nettle; the nutmeg; oak; pareira brava, the root of; peat; Peruvian bark; pepper; periwinkle; rushes and their formation; sage; seeds of trees and plants; tea, its nature and properties; tobacco, the seed of; vinegar; wheat; the willow; various notes on timber, and the best season for selling it.

Structures and Functions of Animals.

Acids in the stomach, and their part in digestion; the blood, its parts, its globules, its minute circulation, its coagulation, the frequency of its course from the heart, and many other details; breath, shortness of; bones and their formation; the brain in different animals and its texture; the eye and its crystalline lens; feathers of birds and insects; fibres of animal flesh; generation of animals, and refutation of equivocal or spontaneous generation; spermatic animalcules; embryology; hair; gout stones; the heart, and its construction in several animals; the intestines, their membranes and vessels; muscular fibre and its construction; nerves and their construction; the optical organs in the eye of a silk-worm moth, a beetle, a shrimp; the optic nerves of the fly; insensible perspiration; quills and their formation; rennet, its nature and properties; stones in the bladder; scales of the human skin and of animals; scales of the lining membrane of the mouth; the spleen, its structure and function; the white matter or fur which forms on the tongue in fevers.

Philosophical Subjects, Various.

Amber; the earth, and phenomena in its diurnal motion; gunpowder, various observations on its nature and properties; the magnet or loadstone, various observations on; moxa used by the Chinese for cure of gout; negroes, and the cause of the blackness of their skins; paper burnt, supposed to be an ancient or vegetable production; the sea, its pressure at great depths, and the cause of its gradual elevation in regard to the land.

Such are some of the subjects of study to which Antony Van Leuwenhoek devoted his industrious life. In investigation he used every means which came under his command, but one means especially. To that let us turn our attention.

THE MICROSCOPIST AND HIS MICROSCOPES.

Van Leeuwenhoek was not merely blessed with industry, he was blessed also in being a fortunate man of science. He flourished at the birth of a new era in scientific discovery, and, taking the lead in the new work, got a reward which must, by necessity, have come to some others if not to him. For him the illustrious Jansens had invented the microscope, and from their invention a few men had begun to unravel the minute unseen worlds of structure and life. Our ever-inquisitive naturalist, getting first hold of this art, and being of a mechanical turn, began to cultivate it; to make new eyes; and, to discover, through what he made, untold, nay majestic wonders,—a new world.

The most curious bit of history, connected with his microscopical researches, is that which bears on the perfect simplicity of the microscopes he employed, and on his own skill in their construction. The simple instruments were all made with his own hands, even to the grinding of the lenses; and in the art of using them he must have been purely self-taught. Both these facts are proved without any kind of doubt in the works of Leeuwenhoek.

What these instruments were we know precisely, not only from their author's own description, but from the circumstance that he bequeathed tweny-six of them, in a small cabinet, to the Royal Society, which cabinet and instruments were presented to the Society through the president, Martin Folkes, were described in the Transactions, No. 380, and were afterwards most carefully reported upon and delineated by Henry Baker in two of his famous microscopical works, "The Microscope Made Easy," 1744; "Employment for the Microscope," 1764.

The description of one of his microscopes by Leeuwenhoek himself is given so clearly in his essay on the circulation of the blood in the tail of an eel that any one with a mechanical mind could construct from it an exact copy of the instrument. On the opposite page, Bertram

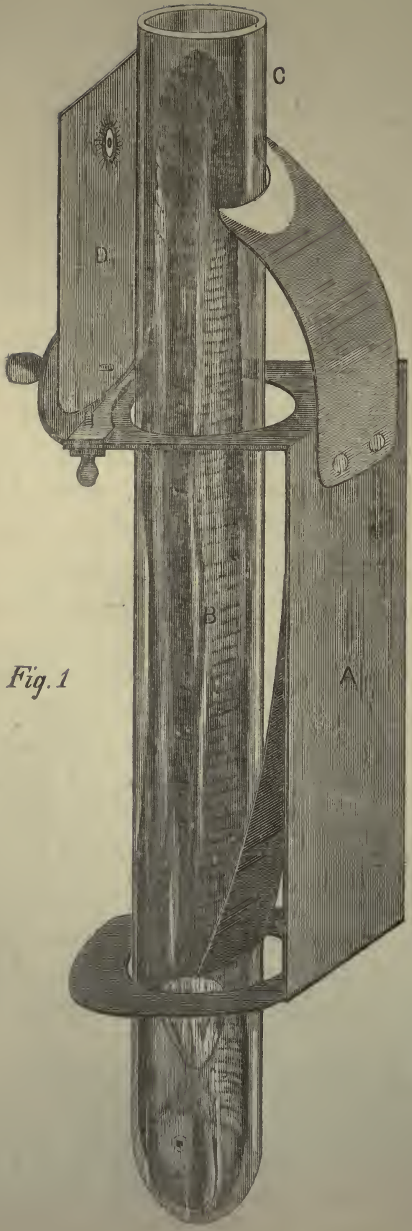

Fig. 1

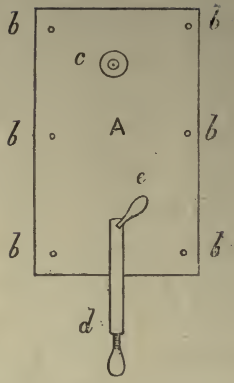

Fig 2

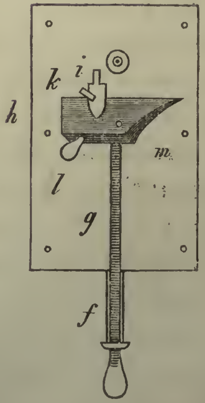

Fig. 3

Richardson has depicted it in fig. 1, precisely as it was when in use by its inventor. A stand of brass, A, with a hole at the top and bottom, was made to hold the object, B, in this case an eel, in a tube of glass, C. The tube could slide up and down according to the will of the observer, and was kept in position by two springs of well-tempered brass. The lens forming the microscope was held in a perforation through the silver plate, D, fixed to a support which stood out at right angles to the frame. The lens, as will be seen, was nearly, but not quite, in the middle of the plate, and opposite to the tail of the eel in the glass tube. The lens, by a screw movement on the plate, could be brought nearer or further from the tube as required. It was a single lens carefully ground. The instrument entire seems to have been held up by the hand, from its frame, opposite to the light, and, when in use, the lens must have been close to the tube, because he tells us that in order to prevent the lens being scratched by the tube, in removing the latter, he caused the metal plate carrying the lens to have a side movement by which it could be turned out of the way when the tube was either removed or inserted.

The microscope thus described was a special one, designed for a special purpose. The microscopes commonly employed, the specimens of which were bequeathed to the Royal Society, were still simpler, and, with drawings of them copied in figs. 2 and 3, are described by Mr. Baker as follows :—

"The two sides of these microscopes are shown in the figures (figs. 2 and 3). The eye must be applied to the side, fig. 2. The flat part A is composed of two thin silver plates fastened together by little rivets, *b b b b b b*. Between these plates a very small double convex glass (called by mathematicians a lens) is let into a socket, and a hole drilled in each plate for the eye to look through, at *c*. A limb of silver, *d*, is fastened to the plates on this side by a screw *e*, which goes through them both. Another part of this limb, joined to it at right angles, passes under the plates, and comes out on the other side (see fig. 3) at *f*; through this runs, directly upwards, a long fine-threaded screw, *g*, which turns in and raises or lowers the stage, *h*, whereon a coarse, rugged pin, *i*, for the object to be fastened to, is turned about by a little handle, *k*, and this stage, with the pin upon it, is removed farther from the magnifying lens, or admitted nearer to it by a little screw, *l*, that passing through the stage horizontally and bearing against the back of the instrument, thrusts it farther off when there is occasion. The end of the long screw, *g*, comes out through the stage at *m*, where it turns round, but acts not there as a screw, having no threads that reach so high. These microscopes are plain and simple in their contrivance, all the parts are silver, fashioned by Mr. Leeuwenhoek's own hand, and the glasses, which are excellent, were all ground and set by himself.

Set
26

"Of the twenty-six microscopes I examined, one magnifies the diameter of an object 160, one 133, one 114, three 100, three 89, eight 80, two 72, three 66, two 57, one 53, and one 40 times."

[illegible]

And now, having seen the instruments, unfortunately long since lost, with which Leeuwenhoek pursued his new lines of research and founded a new department of science, we may, with advantage, in a concluding chapter, glance at the work of this original master from those aspects of it which are of most value to the medical scholar.

[illegible]

THE FOUNDER OF HISTOLOGY.

In the physiological sphere Leeuwenhoek holds rank as the founder of that branch of physiology, or, using a wider term, biology, to which the term histology has been applied. He did not invent the term; it has been invented by workers of a much later day, but he introduced the method and the practice of the science which that term embraces.

Discovery of the Minute Circulation of the Blood.—It is the common idea that Leeuwenhoek was the first to discover the red corpuscles of the blood, and probably ninety out of a hundred persons who recognise his name, do so as the discoverer of the corpuscles. The mistake is absolute. The discovery was made before the time of Leeuwenhoek; he, himself, never speaks of it as his own; and, in plain truth, he made a blunder as to the construction of the corpuscles, which shows that he was not so conversant with them as some of his cotemporaries.

But what he did discover was the final and unmistakable proof, through the sense of sight, of the circulation of the blood. What Harvey had demonstrated by undeniable inference, Leeuwenhoek, in 168[illegible] had made visible to the eye. His credit is that he brought the movement of the blood, through its vessels, under the dominion of the most certain and exact of the senses. He made darkness visible. In what way the indefatigable microscopist performed this task is one of the most fascinating chapters in the whole history of science. It is recorded by its author in two or three of his famous letters, but fully and most completely in one entitled: "*On the circulation of the blood; that it is not discoverable by the sight in any human body, nor* *in the bodies of terrestrial animals: the same completely seen in fishes, and the nature of it particularly described.*"

In this essay Leeuwenhoek begins by telling his readers that the blood is composed of exceedingly small particles named globules, which, in most animals, are of a red colour, swimming in a liquor, called by physicians the serum, and that by means of these globules the motion of the blood becomes visible, which otherwise would not be discernible by the sight. He had often tried to view the circulation of the blood in terrestrial animals, but unsuccessfully, because no parts were sufficiently transparent. He tried the experiment with the comb of a young cock, but failed; he tried it with the gills of the same animal, and then saw it running in an inconceivable number of vessels, but it was impossible to trace the circulation from the immense number of vessels crossing each other in all directions and giving rise to the redness of the structure. After this he made his observations on the ears of white rabbits, by placing the ears before the microscope; but, with all his pains, he could not do more than see the blood running with great swiftness through the arteries and veins. His greatest expectation next turned on a bat, and, putting the membranous wing of one before the microscope, he saw the circulation most clearly both in the arteries and in the veins.

His next great advancement came when he directed his microscope to the tail of the tadpole. Upon examining this, he exclaims:—"A sight presented itself more delightful than any mine eyes had ever beheld; for here I discovered more than fifty circulations of the blood, in different places, while the animal lay quiet in the water, and I could bring it before my microscope to my wish. For I saw, not only that the blood in many places was conveyed through exceedingly minute vessels, from the middle of the tail towards the edges, but that each of these vessels had a curve, or turning, and carried the blood back towards the middle of the tail, in order to be again conveyed to the heart. Hereby it plainly appeared to me, that the blood vessels I now saw in this animal, and which bear the names of arteries and veins, are, in fact, one and the same, that is to say, that they are properly termed arteries, so long as they convey the blood to the furthest extremities of its vessels, and veins when they bring it back to the heart. And thus it appears, that an artery and a vein are one, and the same vessel prolonged or extended."

In further observations he describes how he found that in the course of the corpuscles of the blood through the minutest passage from the artery into the vein one globule passed at one time, and this he opined must be the plan in all animal forms up to man himself, that is, one fine vessel for one globule.

From the tadpole he passed to the frog, viewing the circulation in the web of the foot, and explaining, by the way, that the red colour of the blood is due to the accumulation of the globules. After the frog the tails of fish were examined in the same manner and with the same results. After the fish the eel afforded him the means for another of the most remarkable of all his studies.

The temptation is pressing to tender addition upon addition to this portion of the life-work of our discoverer. Every sentence, indeed, of the chapter now in hand is a revelation. The minuteness of the smallest vessels is dwelt upon as a necessity for the equal and universal nutrition of the body. The change of colour in the blood, from bright arterial to venous, is shown as occurring in this part of the circuit of the blood. The fact that the blood yields its nutritious fluids to build up structures through the infinitely thin walls of this minute circulation is expounded; and the effect of arrest of the circulation is elucidated with a perspicuity that is positively astounding. He had noticed that blood when extravasated from a bruise is coagulated, and fixed for a time in the bruised part, but that after awhile it is dispersed. He had been of opinion that in this dispersion, when there is no "exulceration," the blood is dissolved and carried off by perspiration. But in the tail of a tadpole he observed an obstruction in a vessel from a coagulum, giving rise to a to and fro movement in the vessels on the heart side; he noticed that, in time, this movement dilated subsidiary vessels; and that, finally, it succeeded in slowly removing the clot altogether. From this observation he reasoned out the time it would take to remove an extravasated portion of blood, and supposing the blood to be driven from the heart at the rate of 75 strokes a minute, 4,500 an hour, 108,000 in a day and night, and 1,080,000 in ten days, he held that in ten days over a cubic inch of blood would, by this gradual resolution, easily be removed, with restoration of the circulation to its natural course. In another observation, in continuation of the same inquiry, he saw anastomosis, and, to his great surprise, witnessed the sudden formation of a new minute artery and vein below an obstructed part.

Discoveries in Animal Structures.

On his discovery of the minute vascular circulation the immortal fame of Leeuwenhoek rests. But when that is said there remain many more discoveries, which added together bring forth, perhaps, as great a result. In his description of the structure of bone and tooth, Leeuwenhoek went half way towards Clapton Havers and the Haversian system. The tooth he admirably delineated. He discovered the fibres of the crystalline lens and their distribution, leaving a drawing of them which is still repeated and republished. He unravelled voluntary muscular structure into fasciculi, fibres, and filaments, defining perfectly the "stripe" now so familiar; he showed himself conversant with the membranous sheaths of voluntary muscles, and with the special muscular substance construction of the heart.

To Leeuwenhoek must be accredited the earliest attempts to determine the structure of the brain and of the nerves. He distinguished, carefully, the particular character of the grey matter, and supposed that its darker or grey colour was caused by the greater number of blood vessels which pass into it; while, with equal care, he explained the fibrous structure of the white matter. He studied the structure of feathers and of hair; determined the squamous nature of the outer part of the skin, and compared that structure with the epithelial scales of the mucous membrane of the mouth. He gave a very clear account of the fibrous structure of the spleen, and some really beautiful illustrations of the blood vessels and membranes of the intestines from a specimen which had been brought to him by Professor Bidloo, the colleague of Boerhaave, of Leyden.

Discoveries in Pathology.

To these contributions to histology on its physiological side must be added others which are pathological.

The liver fluke in sheep was well described by him, and a curious hypothesis supplied in respect to this fluke, viz., that in dry seasons it dries up and is buried in the earth of the meadows, from whence, in the wet seasons, it rises to the surface and, under the influence of the moisture, revives. He investigated calculi from the bladder, and, treating of their solution by medicines taken internally, declared that those physicians who pretended to have medicines of solvent efficacy were "like blind men talking of colours." He also investigated the "chalk stones" found in persons affected with gout, and supplied some views on the nature and value of the moxa in relation to treatment. On the pathological side, however, the most original observation of Leeuwenhoek relates to his researches as to the cause of the whiteness or fur of the tongue in fevers. Up to his time it had been conceived that this white matter or fur proceeded from fumes or vapours rising from the stomach, which view he disputed on experimental evidence. In September 1707 he suffered from an attack of fever, and on the fourth day of the disease, on looking at his tongue with a magnifying glass, he saw it white. Thereupon he scraped a little of the white matter off with his penknife, and, after examining it with his microscope, came to the conclusion that it was an exudation from the serum of the blood. In 1708, under like circumstances of fever, for which—as he takes peculiar care to inform us—he swallowed no medicine, he again examined the fur from his tongue, to find in it an immense number of minute hair-like particles. Some portions of the fur he boiled in pure water, by which the particles were separated. These particles he washed with rain water, and placed in a glass tube, and later on he found the water laden with an innumerable quantity of animalcules, which he imagines were nourished by the particles.

In the organic deposits which form between the teeth, even between teeth which are kept well cleaned with salt and rubbed hard with a cloth, as his own were —so that few persons at fifty could show so good a set,— he extracted a sort of white substance like a mixture of flour and water, which, mixed with pure rain water, showed some kinds of small animalcules, the motions of which "were very pleasing to behold." He obtained the same from the teeth of two ladies who were very punctual in cleaning their teeth; while from between the teeth of an old gentleman, who was less particular, he secured an incredible number, so that the water which contained them "seemed to be alive." Toothache in a hollow tooth may, he thought, be sometimes caused by eggs from the cheese maggot lodging in the cavity and developing there. To this view he was led by the examination of three small maggots which had been sent him by Sir Hans Sloane, with a letter stating that they had been found in a person's decayed tooth, and had been expelled by fumigation. These maggots he detected were "the offspring of a small fly, which lays its eggs in cheese."

From examining the skin Leeuwenhoek came to the conclusion that a callus of the cutaneous service is only caused by a great number of scales heaped one upon another, and suggested that the removal of stains from the hands is ensured by the rapid casting-off of scales. He used the microscope also for the first time in what might be called a medico-legal inquiry. A Mr. Yonge sent to the Royal Society a bunch of hair which he supposed had been voided from the bladder by a female patient. Leeuwenhoek examining the substance microscopically, declared it to be wool from the heel of a stocking.

Researches Analytical and General.

In some chemical researches Leeuwenhoek also led the way. He discovered the oblong saline particles of coffee; the saline crystalline matter of tea; the animal nature of cochineal; the nature and structure of the gall nut; some changes in phosphorus under heat; and many other curious natural phenomena.

Lastly, he made many new and valuable observations of a more general kind, which were as original as they were important. He collected in a closed vessel the water which exhaled from one of his hands, and by that research estimated that he perspired from his whole body twenty ounces of fluid an hour. He calculated the pressure that was exerted on the eye of a whale 8,400 feet under the sea as equal to 23,100 pounds, or one ton six hundred and a quarter of a hundred weight. He advanced a view that fishes never die of old age, because their bones never grow hard; and, reflecting on the enormous bulk of certain marine animals, such as whales, he conjectured that some of those which were taken at the beginning of the whale fishery might have been over a thousand years old. He calculated the ages of trees, like the oak, by the circles seen in a transverse section, and explained how the circles are produced.

In 1677 Ludwig van Hammer, of Dantzic, drew his attention to the spermatozoa which he had seen three years before, but had not properly recognized. After this he examined these bodies from various animals—from whales to spiders. In these researches he contested vehemently, with Dr. Lister and others, against spontaneous generation, proved the saying of Harvey, *Omne virum ab ovo*, and founded the science of embryology. He studied the theory of fermentation of blood, and by experiments on the extraction of air from blood, in which he exhibited most original ingenuity in the invention of pumps for the extraction of gases from blood, from serum, and from water, he declared against fermentation on the ground of absence of gaseous products in blood. He inferred that the corpuscles of the blood could not contain air because, as they sink in the serum to the bottom of the containing vessel, they must be specifically heavier than the serum. He criticised the opinions of the medical men of his time, who when called to sick persons complaining of pains in this or that part, tell them that the wind has got into that part, or that it is a windy complaint, and the like! He wrote a history of a great storm on the 8th of December, 1703, telling that his house, which faced the north-east, was so visited that the windows were coated with crystals which the microscope showed to be of common salt, and predicted that where salt had fallen on the earth there would be fruitful growth,—a prophecy that was fulfilled, and would add, doubtless, to the common belief that he was a "conjurer." He wrote a note on a German who pretended to cure diseases by sympathy; and at eighty-five years, in response to a suggestion by a respectable gentleman that, notwithstanding his advanced age, he should go on with his inquiries, because "those fruits which ripen in autumn are by nature the most durable," he wrote an essay on the formation of rushes and on the structure of nerves. But here I must cease, or I shall commit myself to a volume instead of a chapter.

Such are a few of the physical advances of this truly great Dutch philosopher. They were blurred by one or two obstinacies;—a refusal to admit the existence of perspiratory openings on the skin; an idea that the blood does not go round the body fourteen times an hour; and, that the arterial pulse is not caused by the direct motion of the heart; but what greatest work of man is free from some blurr? When the new knowledge and new discovery of this man is collected, what a monument of industry, insight, genius, is revealed!

Ultima Linea.

In Delft on August 28th, 1723, our Bedellus immortalis of that place, and of all places, yielded up his spirit after a terrestrial conflict of ninety-one years. We may suppose that he died after a completed career of body and mind. We know that he died in the profound respect of all who knew him, and that he was laid in the choicest earth his fellowmen could find, the old Reformed church of his fathers, in which edifice the remains of the famous Admiral Van Tromp already reposed. In his life he had many scientific contemporaries whose names, like his, are of undying fame. But for real greatness of originality and industry, as a revealer of nature to man, he had, I humbly think, only one head above his own, that of the mightiest of the mightiest, of Isaac Newton.

OPUSCULA PRACTICA:

USEFUL NOTES FOR BUSY PRACTITIONERS.

> "There are mites in science as well as in charity."
>
> Benjamin Rush.

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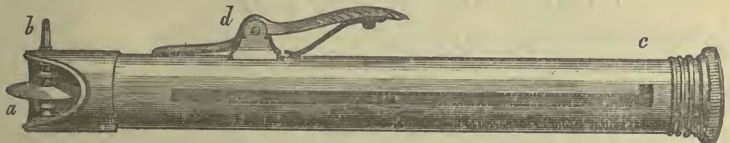
A PAINLESS CUTTING KNIFE.

IT occurred to me many years ago to invent a knife which would divide living structure with such rapidity that the pain of cutting would not be felt. The first attempt of this kind was a knife of a circular shape, which by a vulcanite spring I got to revolve at the rate of eighty times a second. The knife, as shown in the diagram, was placed at the end of a tube from which it projected.



The tube, at the knife end, was shaped at an angle, so as to allow the blade (*a*) to be easily applied to the part to be divided. Two cords from a vulcanite spring enclosed in an inner tube were wound round the shoulders of the blade (*b*) by a key. The spring was then made tense by pulling the inner tube out and fixing it out at the bayonet catch (*c*). In use, the circular knife was brought over the part to be divided, and the blade, let loose by pressure upon the trigger (*d*), flew round and made the incision.

I tested this knife on myself, and showed its action many times, reading a paper upon it and exhibiting it at the Leeds meeting of the British Medical Association in 1869, and at a medical meeting in York, in the same year. I also used it for opening abscesses with perfect success. The knife cut without communicating any sense of the cutting whatever, at the time of the incision. It was not, however, a practical instrument, as the springs soon lost their power, and sometimes broke while in action. Its value consisted in proving from it that it was correct in principle.

Since that effort I have often endeavoured to improve on painless cutting, and recently I have made an advance by constructing a knife in which the blades, lying closely, side by side, are made to cut rapidly at the same time in opposite directions, that is to say, across each other with their sharp edges parallel. I had hoped to give a full description and diagram of this knife in the present Asclepiad, but as it requires modification in one or two details, I must revert to the subject in the next number.

PEROXIDE OF HYDROGEN IN EPILEPSY.

SOON after I had introduced peroxide of hydrogen into medical practice, in 1859, I tested its value in five well-marked cases of epilepsy. In the first and second of these cases the paroxysms, which had been frequent, occurring at intervals rarely exceeding five or six weeks, appeared to be held off by the medicine. The first patient believed herself cured, but after a time relapsed. In the second case there was no paroxysm for five months, then a severe paroxysm and relapse to the old condition in spite of the remedy. The good results were, therefore, in these cases problematical—*i.e.*, some other and unknown agency might have been in useful action coincidently with the administration. In a third case, that of a lady who was given to literary pursuits as the best means of killing time and forgetting her disease, the peroxide solution was taken in the proportion of one fluid ounce a day for eleven months, after it was first prescribed. She then returned to me to report that in the whole of the period she had had but two convulsive attacks, and that in neither did she lose her consciousness. Her own faith in the value of the remedy was unbounded, so that it was hard to say, although the practical result was excellent, whether the result was due to the mental impression or to the physical operation of the remedy.

In a fourth case very extreme, in which, I think, every reasonable mode of treatment had been resorted to, I pushed the remedy for four months, the patient at first believing himself better. I could not for my part see any real improvement, and the case ultimately proved fatal from general paralysis.

The last case of epilepsy ought strictly to be called hysterical epilepsy, the attacks, nevertheless, being very severe, sudden, and frequent, with unconsciousness and lividity. I should call them true epileptic seizures at once, but for the fact that there were, usually, emotional symptoms either before or after the convulsive paroxysm. This case is of interest, because from the first administration of the peroxide the patient herself and her friends were as satisfied as they were of any other observation they could make that the attacks were reduced in number and intensity by the medicine, and were warded off by it. Hence, for over seven years they had the peroxide always at hand, their confidence in it no jot abated. The husband of this lady, himself a professional man, was more decided than anyone else that a positive good belongs to the administration; and, ultimately, there was complete recovery.

Since the commencement of this research, twenty-five years ago, I have often prescribed the peroxide in epilepsy, and with remarkable results, as if the medicine, acting, physiologically, after the manner of potassium bromide, had a controlling power. It certainly deserves a much more extended trial. The peroxide used should be in the form of what is called the ten volume solution, and should be commenced in fluid drachm doses taken three times a day in half a tumbler of water, increasing the dose gradually to two or even three fluid drachms. The metallic taste the solution leaves on the palate is reduced by the addition of a fluid drachm of pure glycerine to each dose.

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SEPTINOUS PNEUMONIA.

IN the past quarter I have had to treat, in the person of one of my medical brethren, a striking instance of what may be called septinous pneumonia, induced by inhaling some toxic product from a cesspool. The patient, who is in the prime of life, who has usually enjoyed good health, and who lives in a part of the country noted for its general salubrity, had been suffering from a cold, followed by a little bronchial cough. The symptoms were not so severe as to prevent him from following his usual professional work. On Wednesday, August the 19th, after playing a game of lawn tennis, he reclined on the ground, which was extremely dry, and was afterwards seated so near a large cesspool as to be unpleasantly conscious of emanations from it. Some hours later he was seized with nausea and rigors, followed by difficult breathing, pain in the chest, spitting of free quantities of rusty sputa, and fever. For forty-eight hours the symptoms continued to become more and more severe, and on Friday the 21st, when I made my first visit, I found general congestion of the right lung, crepitation at the anterior surface, a pleuritic rub, and a temperature of 104° F. : in brief, all the conditions of congestive pneumonia with pleurisy. The disease for five days ran a very severe course; crepitation became marked in the left lung as well as the right, with pleuritic friction also there; but on the sixth day the worst signs began to subside, and recovery would have been almost as rapid as the development of the mischief, but that an aphthous rash on the fauces, accompanied with considerable superficial redness and soreness, caused a few days' delay.

I treated all through with large doses of sodium salicylate, ten grains every three hours, combined with fluid drachm doses of aromatic spirit of ammonia, a blister over the part where the pleuritic pain was most severe, and an occasional dose of Dover's powder made with chlorate of potassa as a substitute for the sulphate. By this all that was needed, medicinally, seemed to be fulfilled with little expenditure of vital power.

This is the second case of septinous pnuemonia which I have recognised since my eyes have been opened to recognise such examples of disease, although I dare say, if the expression be permitted, I have all my life been blindly seeing them. But what is the septinous agent which acts so rapidly, inducing paralysis of the pulmonary circulation and all the consequences? The phenomena are so akin to those which, in experiment, I produced by the prolonged inhalation of the nitrite of amyl, I can but suspect that an organic nitrite, either directly inhaled or resulting from some local fermentative action in the pulmonary structure, is the determining cause of the symptoms and their consequences.

DOVER'S POWDER AND ITS MODIFICATIONS.

IN cases like the above there is no anodyne equal to Dover's powder, no other such a soporific febrifuge. If I could envy any one, as a therapeutist, it would be the old physician who originally had the happy thought of blending astringent opium with relaxant ipecacuan, and both with a diuretic and laxative. I suspect that Dover's name, though so little is known of the man himself, is more frequently quoted than that of any other physician. This by the way, that which I have in my mind is to suggest that it is often very good practice to modify Dover's powder by combining the one grain of opium and the one grain of ipecacuan with other salines than sulphate of potassa. The true Dover's powder contains nitrate of potassa as well as sulphate, four grains of the nitrate to four of the sulphate, and it often seems to me reasonable to revert to this form, the nitrate of potassa being, in small doses, a good diuretic. I, also, very often venture to prescribe the powder with other modifications of the saline part, and with advantage. In acute rheumatic fever I usually substitute sodium salicylate for the potash salt; in gout, bicarbonate of soda; in remittent febrile cases, two grains of quinine with five of sodium salicylate; and in tonsilitis and other febrile throat affections, chlorate of potassa. It would surely be worth the time and skill of one of our scientific pharmaceutical brethren to prepare and bring out a series of Dover's powders in these modified forms.

THE POSITION OF THE BODY FOR SPHYGMOGRAPHIC TRACINGS.

TWO tracings were brought to me taken within a minute or two of each other from the same person and from the same pulse, the right radial, but presenting striking differences in the readings. The operator was much perplexed, and was inclined to think that the value of the sphygmograph as a means of diagnosis was impugned. On looking at the specimens, I detected that the difference lay in the simple circumstance that one reading had been taken while the patient was in the sitting, the other while he was in the standing position, and that the difference really showed the correctness of the record. In sphygmography, the fact should always be remembered, that the natural pulse is quicker when the body is standing than when it is sitting, and quicker when the body is sitting than when it is recumbent, and that the number of strokes recorded on the paper, as well as the character of the strokes, is, in this manner, modified by position. It is best practice therefore to take the reading with the patient in the same position each time, and, all things considered, I think the sitting position is the most convenient and satisfactory. There is less embarrassment and less fatigue in the sitting posture, and the wrist is supported most steadily. In some cases, of which I may have occasion to speak another time, it is important to take readings under all three positions. For the present moment I wish only to suggest a general rule best adapted for saving time in the necessary hurry of practice.

SURGICAL METEOROLOGY.

THE Time is Favourable for Operation :—

(*a*) When the barometer is steadily rising.

(*b*) When the barometer is steadily high.

(*c*) When the wet-bulb thermometer shows a reading of five degrees lower than the dry-bulb.

(*d*) When, with a high barometer and a difference of five degrees in the two thermometers, there is a mean temperature at or above 55° Fahr.

The Time is Unfavourable for Operation :—

(*a*) When the barometer is steadily falling.

(*b*) When the barometer is steadily low.

(*c*) When the wet-bulb thermometer approaches the dry-bulb within two or three degrees.

(*d*) When, with a low barometrical pressure and approach to unity of reading of the two thermometers, there is a mean temperature above 45° and under 55° Fahr.

REFLEX PAIN FROM MENTAL SHOCK.

I HAVE observed very often that some persons of both sexes experience an acute twinge or pain on the reception of any news or intelligence that conveys what is called a mental shock. The term usually applied to this is "shock to the nerves," and such literally it is. The shock, in its acute form, is sharp, short, and through the body from one of the senses to some one particular part or spot of the body. The spot is not always the same in every person, but it is, I believe, always the same in the same person, is limited in range, and is, perhaps, invariably in the back part of the body. In most persons the pain is across the middle of the back, and is very frequently described to be a sensation, as if "the back opened and shut"—a singular saying, and one that would be absurd were it not commonly employed by persons of varied classes, habits, and education, to describe what they feel. In some persons the pain is felt lower down in the back, across the sacrum; in others in the back of the thighs; in few in the back of the neck.

The character of the pain is very uniform. It follows instantly upon the reception of the mental shock. As is usually expressed, the pain "shoots through to the part." It is not a spasmodic pain, it is not a neuralgia, it is a sudden ache, lasting from a few seconds to ten or fifteen minutes. It is often attended by a sense of acidity in the mouth, and by the teeth being "set on edge." It may be followed by distinct muscular tremor, and, in bad cases, by so much failure of muscular power, as to cause, for a short time, an inability to stand steadily on the legs. The pain is sometimes sufficient to lead the sufferer to call out, and I have known it produce a faintness or feebleness, which was not recovered from for several hours.

The shock, as it seems to me, is purely mental, and is, as a rule, the result of intelligence suddenly conveyed, either by being heard or read. In some sensitive persons it is so easily induced that, what would be to others the merest incident, is to them a certain cause of the reflex pain. It may seem an extreme statement, but it is no less extreme than true, that I know one person who though not generally considered among friends as a nervous person, can never hear related or read in the papers the notice of the death of a friend or an acquaintance, or hear or read of an accident, without —in spite of the most resolute determination not to give way—experiencing as serious a shock as if a sharp electric shock had passed through his body. Indeed, the shock seems to partake of the character of an electrical discharge, and to be, like it, independent of the volition. It resembles the electrical shock also in the after-effects of acidity which it induces.

I am a little in doubt whether the reflex is ever induced by what is called an appalling sight, like the sight of the infliction of a wound, or of a person falling from a height. I have certainly known some who suffer readily from the dorsal pain whenever bad intelligence is suddenly brought to them, who do not experience it when they see anything that affects them strongly, even so strongly as to produce in them a sense of giddiness or faintness. And yet the shock may be induced by receiving written intelligence through the eye as well as the ear.

Occurring through the eye the shock causes less reflex pain than it does through the ear; a fact which may be explained by the reasoning of Dr. R. M. Bucke, in that chapter of his admirable work, "The Moral Nature of Man," which relates to the physical basis of the moral life. There this learned author argues that it is reasonable to connect, from its structure, the auditory nerve with the sympathetic system of nerves, as if it were a part of that system which, as we now conceive, is the seat of the emotional nature, and through which pains and sympathies are expressed.

In the ordinary course of events, the reflex pain which is now under study is a result following as immediately upon the infliction of the shock producing it as a reflex act can follow, and it may not recur without a further new and distinct shock. But there are persons in whom the mere recollection of an event that has once caused the pain will reproduce it. I know of more than a single instance in which the remembrance of a particular acute mental blow will cause the reflex pain almost as severely as the original impression. The primary shock, stored up, is disengaged in recalling it by an act of memory.

I have said that the pain is, commonly, of short duration. This is true. There are, at the same time, cases in which, from a combination of influences, the pain is more permanent. I knew an instance in which a medical man, on being summoned in an unexpected and sudden manner to see a near relative whose life was despaired of, experienced the reflex pain very severely in the back, and, being pressed for time to reach a train exerted himself extremely to catch it, setting, for the moment, the pain at defiance. He succeeded in his effort, got his ticket, entered the carriage, and sat down to get rest. No sooner, however, was he seated than the pain in the back returned in rapid darts, which made him start forwards and feel as if he did not dare to breathe. He found that by holding his breath he obtained relief, and by keeping resolutely quiet in one position, with the body bent slightly forward, he did, in time, gain relief from the severity of the seizure. The relief was not complete. The pain returned to him many times during the journey, especially when there was a little concussion with the carriages. At the end of the journey he found a difficulty in standing upright, and for many days he had a stiffness and pain which he compared to lumbago, accompanied all through by the peculiar sense of acidity in the mouth, and of the teeth being "set on edge."

Of the existence of the phenomenon of reflex pain from mental shock there can be no doubt. There are very few persons, I believe, who have not felt it, and the marvel to me is, that it has not been defined by previous observers. It is as if the very familiarity of it had kept it from being systematically described. It is none the less important on that account. As a phenomenon it is full of interest. It shows how certainly physical shocks may be transmitted by what seem to be immaterial influences through the senses. Is it that tension of the vibrating nervous receptive surface causes an external vibration to extend through the nervous system in such excess that there must somewhere be escape, as for an overflow of nervous current? It would seem so; and it would further seem as though the overflow was by a reflex movement from the emotional centres of the dorsal sympathetic ganglia to the cerebro-spinal nerves, which supply the dorsal muscles with motor power. The pain, I doubt not, is from the sensitive fascia, and is produced by muscular spasm and pressure on peripheral nerves. It is similar to the back-ache caused by long stooping in a constrained posture, but is more intermitting and acute while it lasts.

In worst examples of mental shock affecting the body through the senses, the reflex from the ganglionic centres is from all points, and is ventral or visceral as well as dorsal. Then the stomach and intestines share in the general disturbance, and intestinal and vesical spasm, nausea, arrest of the diaphragm, arrest of the heart, pallor, giddiness, coldness, and syncope follow. Then men are, as the poet puts it:—

> "Distilled to jelly by the act of fear,"

the reflex dorsal pain a part only of the more general and widespread catastrophe.

The effect of these great waves of motion, entering by the senses, overwhelming the centres, and, by the excessive reflex, inducing phenomena of pain and derangement of involuntary functions, suggests that in the normal course the external waves, condensed through the senses and always in progress, have their normal outlets in what we call involuntary movements; movements flowing into us, through us, and ever wending their way from us, that we pass not into pain, fever, tetanus, and death.

STUDIES TOWARDS A MODEL ANÆSTHETIC FOR GENERAL ANÆSTHESIA.

IN the last Asclepiad a synopsis was rendered of the various chemical substances which have been introduced as anæsthetics. It may be well now to cull from that long list a few of those anæsthetics which are most useful, to study their action, and from that study to try and gather such new truth as may tend to lead us on our way towards discovery of better and safer agents of their kind.

In commencing this task, we may with advantage reduce our inquiries to two of the series of anæsthetic agents, included in the methene and ethene groups. We may also, in studying these groups themselves, reduce the members of them to those that are included in the chlorides and oxides, as the best of all the groups, and as constituting, if we except the one representative of the nitrogen series—nitrous oxide, for which a distinct essay must be reserved—all the anæsthetics which up to the present day have found the greatest favour.

In the present attempt I shall place the observations that have to be offered under a few heads, as if each were a particular study or essay, with a short concluding chapter, from what has gone before, on the lines of research towards a perfect anæsthetic for general anæsthesia.

THE CHLORIDES AND OXIDES OF THE METHENE AND ETHENE SERIES.

From almost the first introduction of the bodies of the methene and ethene series it has been a question whether the chlorides or oxides, that is to say, the haloids or ethers, should have preference. We began with an oxide, ethylic ether ($C_4H_{10}O$); we moved to a haloid, chloroform ($CHCl_3$), and, changing the particular representatives of each class, we have oscillated between the groups up to the present time. At the present moment the theoretical opinion is in favour of a return to the oxides, but I believe that practically the chlorides still have the preference. They are readier for use than the ethers; more rapid in action; less objectionable in after-effects—good qualities which, in many minds, compensate for the greater risk to life involved in their application.

Essentially the anæsthetic agent is the same in both, namely, the radical with which the element chlorine or oxygen is combined. The good or bad qualities of either series rest on chlorine in the one case, oxygen in the other, as the combining element. Neither the chlorine nor the oxygen are anæsthetics, but they confer physical qualities to the compound in which they figure, which play an important part in anæsthesia. Perhaps, indeed, in the radical itself the hydrogen may play no part as an anæsthetic proper. The carbon, in a state of vapour or gas combined with the hydrogen, may be the true narcotizing agent, and

I believe it is; but, for the moment, it is best to say the radical is the anæsthetic base.

The combining element—chlorine or oxygen—with the radical methyl or ethyl have properties of their own, though not anæsthetic. Chlorine is more than twice as heavy as oxygen, so that in combination it yields heavier fluids and vapours with the radicals, than the oxides or ethers. Chlorine combines with the single radical, and in proportions varying from one part of itself with three of the hydrogens of the radical, as in methyl chloride (CH_3Cl), to three parts of itself with one of the hydrogens, as in chloroform ($CHCl_3$); or with the carbon direct, to the exclusion of all the hydrogens, as in carbon tetrachloride (CH_4). Oxygen, in the oxides we have hitherto used, has no such accumulating property of combination. It combines in one proportion only with the radicals, and in combining unites with the radical doubled, as in common ether $\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O$, so that with the ethers we approach more nearly to the anæsthetic base, and, in fact, secure in them an action very much like what is obtained from those hydrocarbon gases in which the elements carbon and hydrogen stand alone, as in ethene or olefiant gas (C_2H_4).

These physical differences greatly modify action. The chloride anæsthetics are more condensed than the ethers, they are less volatile, they are less diffusible; and, what is of more importance still, they are less soluble in the blood, are more easily separable from it, and may more readily exist, as vapours, in the body, in the actual condition of vapour; hence, also, they are more rapidly eliminated from the body.

There is another point, physiological rather than physical, connected with the anæsthetic chlorides and oxides. Chlorine is an irritant; oxygen is negative in its action, unless it be ozonized, and, if anything, sedative rather than irritant. These actions extend through the anæsthetic agents we are studying. The chlorine in the chlorides counteracts the paralysing influence of the radicals, and exalts involuntary muscular irritability. The oxygen has no such effect. The chlorides, consequently, favour arterial spasm; the oxides arterial paralysis. A distinction of the first order.

PHYSIOLOGICAL DISTINCTIONS ON THE GENERAL CIRCULATION.

In 1867-8 I conducted an extended research on the action of the chlorides and oxides, and the conclusions I then arrived at—conclusions I see no reason now to depart from, founded as they were on careful experiments—are:—

1. That when chloroform and all the other chlorides of the methyl and ethyl series are administered by inhalation to healthy bodies, their first action, as they diffuse through the different organs, is exerted directly on the muscles, which they call into powerful contraction. 2. That this action, extending to the arterial muscular system, suspends the influx of blood, and leads, in return, to complete relaxation of the muscles generally, and to arrest of cerebral function. 3. That the heart, if its coronary canals and its walls be sound, lives through the changes better than any other structure, and, in short, is the organ on whose power the ultimate recovery rests. 4. That rapid death from chloroform in the healthy animal is due to failing respiratory power, and, resulting from contraction of the pulmonary vessels, by reason of which the current of

blood from the right to the left side of the heart is arrested.

This view associates all the phenomena of death from chloroform; it accounts for the stage of muscular excitement, the cessation of the beat of the pulse while the heart is still beating, the continuance of the action of the heart when the respiration has stopped, and the white and bloodless condition in which the lungs are discovered when death is complete.

This same view tallies moreover with all the known facts respecting sudden death under the influence of the chlorides in cases where the heart is not healthy, where, unable to live through the preliminary excitement into which, with the other muscles, it is thrown, it ceases action altogether, overcome by the excitation to which it is subjected. A little want of elasticity in the coronary arteries, an undue tendency to contraction in them, a deficiency of power from interstitial deposit in the muscular substance—any of these conditions is amply sufficient to account for death from the heart under the influence of the exciting chlorides.

Under the action of the oxides of methyl and ethyl the living body avoids these dangers. Under the influence of the oxides there is from the first very little excitability of the muscular mechanism; and when they ultimately kill, the act is not by contraction of vessels, but by congestive asphyxia. They have one common action on the pulmonary circulation. So soon as they cause any distinctive symptoms they produce the congestive condition. However quickly we may narcotise with these ethers, and however quickly the narcotism may be carried to death, the lungs are found charged with blood, and the left as well as the right side of the heart filled with blood. The column of blood through the course of the pulmonary artery and its returning veins continues unbroken, and the death that ensues is, truly, from the imperfect aeration of the blood, and from the saturation of the blood throughout its volume with the narcotic vapour.

From these circumstances it becomes most easy to resuscitate the body of an animal that has ceased even to breathe from the inhalation of an ether. On four occasions I have succeeded, with double acting bellows, in restoring life seven minutes after the complete cessation of the respiration, and with methylic ether I have rarely failed to restore after a period of five minutes. I have often restored after twelve minutes' cessation of respiration.

The direct action of the ethers upon the pulmonary vessels is to produce general vascular paralysis. The paralysis is not, however, so instant as when nitrite of amyl is used. It begins probably from the first moment when the influence of the agent is felt, but it progresses slowly as if with the degree of absorption of the vapours into the blood. From the rapidity of the recovery it would seem also that the paralysis is easily removed—is removed, in fact, as readily as is the agent that produces it, and in proportion to the rapidity of the removal of the agent.

If, when the narcotism from a soluble ether is complete, the congested state be long maintained by a process of slow administration of the vapour; there occur changes incidental to congestion. In the experimental inquiry I found exudation of serum into the pleural cavity, with œdema of the structure of lung; but the almost universal result of the congestion is an accumulation of fluid in the vesicular structure and finer ramifications of the bronchial tract. This occurrence is declared by the development of fine crepitant rale, a sign of marked danger, for when it is presented, the application of artificial respiration may not succeed in saving life, however promptly applied. This danger is very much favoured by cold, and still more by cold and moisture. The mode of death is then by asphyxia simply, when death takes place, and is only indirectly due to the ether. I think it certain that in many of the instances of death after inhalation of ethylic ether in man, the fatal catastrophe has been brought on by this accident. It is worthy of note that animals sometimes die from this exudation after recovery from the narcotic action of the ether, and this same event has occurred in man.

MODIFICATIONS IN THE MINUTE CIRCULATION.

In the year 1870 I conducted another series of researches on the influence of the anæsthetics of the methene and ethene series on the minute circulation of the blood—that circulation which, as we have seen, Antony van Leuwenhoeck first discovered. I prefer to use the term minute circulation, because it embraces the minute arterial and venous, as well as the capillary circulation. The researches were all conducted on the web of the foot in the frog, under conditions which included every possible precaution.*

The narcotic vapours used in the research were hydramyle, chloroform, bichloride of methylene, and absolute ether. In some particulars these acted precisely in a similar way, in other particulars they acted in a way more or less peculiar to themselves.

The first fact I would notice as common to the action of all the vapours used is, that no obvious change in the physical characters of the blood-corpuscles was ever observable; neither was there any noticeable difference in the relationships of the corpuscles to each other. The red corpuscles held their course, so long as they were in motion, unchanged; when they underwent change they afforded the first indication of fatal narcotism.

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* See "Report to British Association for Advancement of Science," 1871, pp. 159—60.

Another fact common to the action of all the vapours used was, that the first sign of arrested movement of the circulation commenced in every case on the venous side of the circulation, and consisted of a sort of pulsation or to-and-fro movement of the current through the vein; soon upon this the venous current became obviously slower and the vein dilated, while the arterial current remained, often for a long time, unchanged.

In every case the minute circulation remained long in force, after the respiration had entirely ceased, and after all evidence of the continuance of life had entirely ceased. On the average the animals ceased to breathe for one hour and thirty minutes after the deep narcotism had set in; yet all the while the minute circulation was still playing with more or less of efficiency, and so long as it continued the chances of recovery were nearly certain. The cessation of the minute circulation was, on the other hand, the sign and proof of irrevocable death.

There was still another effect common to all the narcotics used. The circulation through the capillaries often stopped altogether, and for considerable intervals of time, before the cessation of the circulatory power was absolute. Under this condition the circulation, such as it was, was maintained by the arteries in which the blood moved to and fro with occasional slow steady onward movements. In the veins, too, there were now and then short movements, first as of impulse towards the heart, and then of retreat backwards; these movements in the veins were succeeded invariably by an increased and more perfect action of the arteries. During this state the capillaries were, generally, indistinct, that is to say, no movement of corpuscles through them, into the veins, indicated their course; as channels they seemed empty, transparent, and indistinguishable, and the return of the corpuscular current through them was at all times proof of the speedy return of the activity of life.

These changes were common to the action of all the narcotics named; but there were some other striking changes peculiar to the substances themselves to which I must refer. The peculiarities were traceable, as it appears to me, to the weight, the solubility, and the chemical composition of the substance that was employed to produce the narcotic state.

When the substance was very light, of low boiling-point, and insoluble, the effect of arrest of the circulation was most rapidly developed, and at the same time was most rapidly removed. Thus hydramyle, the lightest, the first to boil on elevation of temperature, and the most insoluble, produced the quickest arrest of the venous current; but from its influence the animal was equally quick to recover, the general signs of recovery being secondary to the local return of the circulation.

When the substance was light and of low boiling-point, but comparatively soluble in blood, the time required to produce the slowing of the venous circulation was prolonged after the insensibility of the animal was complete; even after respiration had stopped, the extreme changes in the circulation were slowly developed; and although the insensibility might be deep and continuous, like to death itself, the actual temporary arrest of the blood current was imperfectly pronounced. Absolute ether, which has a very low specific weight—720°—and a very low boiling-point—94° F.,—but which is soluble in blood to the extent of not less than eleven parts in the hundred, produced perfectly all the effects immediately named above.

When the substance inhaled was comparatively heavier, of a higher boiling-point, insoluble, and contained as one of its elements an irritant, there was introduced a new phase, that is to say, the arterial vessels, as the animal came under the influence of the narcotic, were reduced in calibre. The changes of the circulation in this case were first marked in the retardation of the blood through the veins, then the vein increased in diameter, and there were signs of regurgitation of its blood; these indications were followed by what may be called irregular movements in the capillaries, and by reduction of calibre of the arteries. It was observed, nevertheless, that the narrowing of the arterial vessels, though well marked, was never so extreme as to prevent motion of blood in them; that is to say, the degree of arterial contraction was limited. I consider this to be due to the circumstance that the animal had always ceased to breathe, and the further absorption of the narcotic vapour had consequently also ceased, by the time that the action of the vapour upon the arterial vessels was developed.

During the period when the size of the arterial vessel was reduced, the motion of the blood in the capillary vessels fed by the arterial supply was modified; the blood flowing through the capillary channels moved less steadily, and was forced, if I may so express the fact, in pushes, as if there were intervals of relaxation of the arterial vessels during which the resistance to an impelling power of the heart slightly and slowly yielded. After a time the circulation of the blood through the artery became slower, the capillaries were left empty, the venous current ceased, and a condition of temporary suspension of all circulation supervened, except in the arteries. The effects here named were well marked from the action of all the chlorides; they were seen under the influence of bichloride of methylene, they were still more definite under chloroform.

To sum up, the action on the systemic circulation of the narcotic vapours named was seen to be primarily on the venous current, or, I should more correctly say, was primarily manifested in the retardation of the venous current, secondly in the capillary, and finally in the arterial current. During recovery, moreover, the return of a steady onward current was manifested in the veins earlier than in the capillary and arterial channels. This order of events coincides purely with the order of phenomena of death under the influence of narcotic vapours, as observed both in man and the lower animals. It is, I think, the invariable fact that the right side of the heart in such fatal cases is the first to cease its action, and in animals, when the heart is exposed to the air soon after the death, the right side is the first to recommence action. From these facts the inference, I think, is clear, that the arrest of the circulation, during the narcotism, is primarily a retardation of the venous current, secondly of the capillary, and lastly of the arterial current.

The course of recovery, when recovery takes place, appears to be preceded by some act of relief to the venous column of blood. The motion that remains in the arteries is not the first to commence, neither is the circulation through the capillaries at once manifested; that which happens, as a distinct sign of recovery, is a movement onward by the veins; and, as this movement improves the movement through the arteries improves, the capillary vessels refill, and the circuit of the minute circulation is steadily and perfectly restored.

From these observations on the minute systemic circulation when the body is under the influence of a narcotic vapour of the irritant class, we may infer that the changes of circulation observed do not proceed immediately from an action exerted by the narcotic vapour upon the extreme systemic vessels, but from an obstruction commencing on the venous side, and in the lesser or pulmonary circulation. We see in these conditions that of necessity, in the extreme parts of the systemic circulation of the animal, there has been retardation of the blood through the veins. We may also infer on the fairest, nay completest, evidence that the return of motion, which is seen commencing in the veins in the systemic circuit, is due to a returning current through the breathing-organs; in other words, the renewal of the active life of the animal recommences in passive breathing. The same order of phenomena happens, precisely, during the recovery of a warm-blooded animal, after apparent death from chloroform, under the influence of artificial respiration; for so soon as the animal recommences to breathe, however faintly, its return to life is secured. When a warm-blooded animal is suddenly killed by a large dose of the vapour of chloroform, the lungs are invariably found blanched, the right side of the heart engorged with blood, and the left side empty of blood.

The position then assumed, that the primary arrest of the column of blood during fatal narcotism is in the lesser circulation, we have to ask whether the arrest commences in the heart or in the lungs. The commonly accepted view has been that it commences in failure of the right side of the heart; but I incline to think that this view is incorrect, and that the positive source of failure is in the peripheral circulation of the lung. The vapour inhaled impresses, I think, *immediately* the minute circulation, and acts not by absorption into the blood, but by simple and instant contact with the minute pulmonary vessels, so that there is immediate resistance to the passage of blood through them. Three well-observed facts support this opinion:—1st, the fact already dwelt upon, that in cases of rapid death the lungs are emptied of blood; 2nd, that the arrest of the systemic circulation commences on the venous side of the circulation, and is attended with filling of the veins; 3rd, that immediately after the death of the animal, if the chest be opened and the heart exposed, the right side of the heart, relieved of pressure, will immediately recommence to contract vigorously, showing that it is not itself paralyzed, but is restrained from action by mechanical resistance to its column of blood.

If the theory of the action of narcotic vapours thus propounded be correct, we ought to draw from it this primary lesson, that in introducing new narcotic vapours into practice, the utmost care should be taken to select those only that are negative in respect to their action upon the vessels of the minute circulation. A gas or vapour that asphyxiates but does not irritate may be safer than a gas or vapour that does not asphyxiate and does irritate; for the former, when it kills, kills by a secondary process that is proceeded by a series of symptoms foretelling the danger; while the latter, when it kills, kills often by instantly shutting off the column of blood that is making its way through the lungs, and by so oppressing the heart that every attempt at action, under the condition produced, increases the injury.

ON CONVULSIVE MOVEMENTS DURING ANÆSTHESIA FROM THE METHENE AND ETHENE SERIES.

Under narcotism from the vapours of the chlorine series specially, there are two orders of cessation of the circulation,—the one primary, beginning in the lesser or pulmonary, the other secondary, beginning in the larger or systemic circulation. Coincidently with these changes I have observed, when there has been time for the development of the phenomena, two distinct series of convulsive movements or paroxysms of convulsion. I have noticed the same fact in drowning, and also in fatal sudden hæmorrhage, as in the process of killing some animals, such as sheep. The phenomena are, in fact, best seen in cases of rapid fatal hæmorrhage; and I am led to the conclusion that they have one common interpretation as to cause, the hæmorrhagic convulsions being the purest type of all. The convulsive actions, primary and secondary, are due, as it seems to me, to disturbance of the balance of supply of blood to the nervous and muscular centres. As a mechanism, the mass of nervous matter is the centre of reserved force, while the mass of muscle is the moving centre, the two centres are thus held in direct counterpoise, being connected by an intervening nervous cord, and each supplied with the same blood. The two centres are held in counterpoise by the blood. If there be, then, any disturbance of support in either centre, it is indicated in change of function in the moving centre,—*i.e.*, in change of motion.

When we draw blood from the systemic circuit, or when through the lesser circulation we arrest the free current of blood through the systemic circuit, we destroy the balance previously existing between the muscular and nervous centres. If we could so exhaust the body that both centres should be exhausted evenly together, it is possible that there would be no change of motion in the moving centre; and, indeed, in some cases of disease we see the gradual and equal exhaustion without manifestation of the convulsive phenomena. But in cases of extreme and sudden break of balance, it follows necessarily that the balance shall be broken unevenly. It is in the muscular system that the failure of blood is first felt. The nervous centres, protected from the effects of sudden pressure by their envelopment of bony structure, feel the shock of the exhaustion secondarily. But the muscles suffering a reduced resistance of blood to the nervous stimulus, contract as if they had received an excess of stimulus, and the phenomenon of primary convulsion is developed; a convulsion which in hæmorrhage immediately precedes deliquium or syncope. In brief time, the nervous centres themselves becoming exhausted, the convulsions cease, and none but the muscular movements of the organic life, respiration and circulation, remain. These while they last feed still in a passive way the organic nervous and muscular centres; and if the cause of exhaustion at this stage be stopped and the body be resupplied with means of life, recovery takes place without the necessary return of convulsive action; but if the exhaustion proceed, then follows the secondary phase, the failure of the organic system, and with that a repetition of the phenomenon of primary failure, viz., a second general convulsion, terminating in death.

The convulsion of hæmorrhage is the typical form of the conditions above portrayed; but in death from chloroform and similar narcotics, the phenomena are sometimes equally striking. The convulsion and rigidity which mark the second degree of narcotism indicate the first break of balance between the nervous and the muscular centres; the period of the third and fourth degrees of narcotism, during which there is complete paralysis of voluntary and of conscious power, marks the interval when all life is suspended except in the organic or vegetative system; the final convulsion that precedes death marks and proclaims the moment when the organic system itself breaks down, leaving the whole organism motionless and, as we say, dead.

ON CONDENSATION OF WATER ON THE BRONCHIAL SURFACE DURING NARCOTISM.

It has occurred to me often to observe that the physiological action of narcotic vapours during inhalation is greatly modified by the condition of the atmospheric air in respect to its dryness and its moisture. When the atmosphere is extremely dry, the action of a narcotic vapour is greatly increased, and recovery from its effects is remarkably easy; on the contrary, when the air is saturated with water vapour the action is impeded; and, if the air be at the same time cold and moist, the process of narcotism is often greatly impeded, while recovery after it has been established is prolonged in proportion. But the fact I wish particularly to bring forward is, that when the body of an animal becomes profoundly narcotized, and the insensibility is long maintained, during conditions in which the air is cold and moist, there occurs not unfrequently an actual condensation of water in the minute bronchial passages, which condensation leads to asphyxia, and, if it be continued, to actual death.

There are two causes at work to produce the condensation: the one is the obstacle to evaporation of watery matter from the surface of the animal membrane into the air; the other the deficiency of force in an animal whose general temperature is reduced, to raise the vapour of water from the blood, and to expel it from the pulmonary organs in a state of vapour.

Whenever in any case condensation of water, from the causes named, is set up, the danger continues in an increasing ratio; for the condensation tends to shut off the air from contact with the blood, the temperature of the body is decreased and respirating change is prevented. The accident is, I think, more frequent under the action of the soluble ethers than of the chlorides.

SEPARATION OF VAPOURS WITHIN THE CIRCULATION.

From various observations I have made in dissecting the bodies of animals which have died under the influence of anæsthetic vapours, I have come to the conclusion that, when the less soluble of the vapours are used, there is sometimes a separation of the vapours, after their condensation by the lungs, in the blood-vessels themselves. This is most common after death by amylene and amyl hydride; but I have met with it after sudden death from chloroform. The separation occurs, most usually in the pulmonary vessels, which are filled with an air charged with the vapour. The separation also may take place in the large veins of the trunk and extremities, and in the sinuses of the brain.

When this accident happens, death takes place in the same way as when air or other insoluble gas is blown directly into a vein.

THE FORMULA FOR A SAFE AND PRACTICAL GENERAL ANÆSTHETIC.

From what we gathered above it is possible to suggest what are the necessities for a safe anæsthetic,—an anæsthetic that shall be applicable to long and short operations alike, and shall become acceptable generally from its readiness and safety.

1. It must be a fluid. Gases, however good, are not practicable as agents for general and daily use; and, as at the temperature of the blood they remain as gases, they exert, when dissolved in blood, no action from change of state within the organism. To narcotize with them it is, consequently, necessary to give them in large quantities, even it may be to the exclusion of air altogether. The influence of a gas thus administered is of necessity limited to the briefest interval of time; steady continuance would lead to death from asphyxia.

2. The fluid must possess homogeny and stability. Mixtures of fluids are utterly unreliable. Fluids which easily decompose under the influence of heat or of light are unreliable.

3. The fluid must be of pleasant odour, and must produce no local irritation when brought into contact with any surface. All the fluids which, like chloroform, amylene, and turpentine, cause redness and irritation of surface, cause also, when introduced through the blood, irritability of muscle and rigidity, together with vomiting.

4. The boiling-point of the fluid should be not less

than 110° Fahr., and not over 130°. Fluids which pass into vapour below the temperature of the animal body act practically as gases, and have to be used in free quantities to the exclusion of air; amylene and ether have this fault, the last least. Fluids, on the other hand, which pass altogether into vapour at a point much above the animal temperature, as at 140° or upwards, condense in the pulmonary blood too determinately, and although they create a long sleep, they remain for a considerable period in the body, creating continued nausea and depression from interference with the conservation of the animal heat. Tetrachloride of carbon and common alcohol are objectionable on these grounds. A fluid which should have a boiling-point 20° Fahr. above the body, and other properties equally good to commend it, would be convenient in every respect. It could be easily preserved, and as an anæsthetic it would be alike applicable to long and short operations.

5. The density of the vapour of the fluid should be about 40, taking hydrogen as unity.

6. The last and perhaps almost the essential quality relates to the solubility of the vapour in the blood. Up to the present time no sufficient attention has been paid to this important point. Ether is too soluble, chloroform too insoluble. The mean between these two would be nearest to the requirement.

In *résumé*, the agent wanted is a stable fluid; the oxide of a radical of the methene, ethene, or propene series, or of some similar hydrocarbon base, having a boiling-point of 50° C., 122° Fahr.; a vapour density of 40; a solubility in blood of one part in fifty, at 37° C., 99° Fahr.; and yielding an unirritating agreeable vapour for inhalation.

COTEMPORARY PRACTICE AND LITERATURE.

> "*Every physician will and ought to make observations from his own experience; but he will be able to make a better judgment and juster observations by comparing what he reads and what he sees together.*"—FRIEND.

THE PHENOMENA OF THOUGHT.

DR. G. JOHNSTONE STONEY, long known as one of the ablest of the modern school of physiological metaphysicians, has presented to the public his famous lecture on the question "*How thought presents itself among the phenomena of nature.*" He has published also an abstract of the same (Messrs. Hodges & Co., Dublin, 1885), with explanatory notes, and with an appendix, including a letter to the editor of *Nature.*

In a brief series of notes, the author condenses the view which he has formed on the subject, "How thought presents itself in the phenomena of nature." He premises that every phenomenon of the external world is reducible to motions and their modifications, while all that is in the mind is thought. This motion as it exists in nature must be distinguished from man's conception of motion, which is one of his thoughts,—a very complex thought, no doubt, but not part of the external world. The hypothesis, explained in the shortest possible terms,—(1) as consistent with everything we know; (2) as the simplest hypothesis; (3) as an hypothesis which dispels all the difficulties encumbering the dualistic supposition that there are two kinds of existence,—stands as follows: "That if a bystander were armed with adequate appliances to ascertain what is going on in our brain while we are thinking, then what we should experience to be thought, is itself the remote cause, with several intermediate causes, of that change within the observer's brain, which determines his having that complex thought which he would call perceiving some of the motions in our brain—in short, that what he appreciates as motion we experience as thought."

"If this view," adds the author, "be correct, it will follow that the thoughts of which we are conscious are but a small part of the thought going on even in our own brain, and which would be seen by a beholder as motions, the rest being unconscious cerebration, and as much outside our consciousness as are the thoughts of other people. We are led also to the conclusion that the thought which is going on in the brains of all the animals that exist is but the 'small dust in the balance,' compared with what is going on throughout the rest of the mighty universe."

The idea advanced in these passages is so beyond all the accepted crudity of common learning, it reads like a new chapter of thought itself. It is one of the boldest advances of physical science to explain mental phenomena that has ever been put forward. It is not materialistic, in the full sense of that term, because it admits an external energy which is universal, eternal, omnipresent, omnipotent. And yet it is so material, that it suggests the ultimate possibility of constructing a mechanism, which might be endowed with thought from what is going on, throughout "the mighty universe."

"*NATURAL LAW IN THE SPIRITUAL WORLD.*"

FROM the work above noticed to the "*Natural Law in the Spiritual World,*" by Professor Henry Drummond (Hodder & Stoughton, London, 1884), is a transition of a peculiar and yet instructive kind. The author of "*Natural Law*" is a teacher who endeavours in a truly earnest way to reconcile the worlds of religion and science, or it were perhaps better to say, who endeavours to infuse a refined and spiritualised Christianity into science. He blends texts from Paul with texts from Spencer, the Sermon on the Mount with Juvenal and Ruskin. It is all, nevertheless, reverent, and, from the writer's point of view, relevant. The book bears reading by men of science from first to last, but will probably be much more largely read by the professors of religious teaching, to whom it is as a new light opening the way to subjects of the deepest moment, in a manner not before essayed. The chapter on Biogenesis is one of the most singular efforts of the work, and affords on the whole the best key to its intention. In this chapter the distinction is attempted to be drawn between the spiritual man and the natural. The difference, it is held, is not a difference of development, but of generation. "It is a distinction of quality, not of quantity." Were we to construct a scientific qualification, science would compel us to arrange all natural men, moral or immoral, educated or vulgar, as one family. One might be high in the family group, another low; yet practically they are marked by the same set of characteristics; they eat, sleep, work, think, live, die. But the spiritual man is removed from this family so utterly by the possession of an additional characteristic, that a biologist, fully informed of the whole circumstances, would not hesitate a moment to classify him elsewhere. And if he really entered into these circumstances, it would be not in another family, but in another kingdom."

This quotation carries the book, not as to learned details, which are abundant, but as to essentiality of argument and purpose. The difficulty of accepting the argument lies in making the choice of a biologist who could enter into all "the circumstances," and in permitting the mind to be bound hard and fast to certain beliefs—shall we call them dogmas—which their author finds it necessary to insist on. "The biologist cannot devitalize a plant or an animal, and revivify it," says Mr. Drummond. Were it not better to say the biologist has not, as yet, made this discovery? To say he cannot is another question, for the solution of which we must wait and work. Meantime those who differ from Mr. Drummond should not, therefore, neglect him. The heights of pure science are not so lofty that those below them are out of measurement, though some, supposed to reside on those heights, think they are.

EPIDEMIC CHOLERA.

PROFESSOR A. P. PALMER, of the University of Michigan, whose admirable "Practice of Medicine" has more than once been noticed in these pages, has published "A Treatise on Epidemic Cholera and Allied Diseases" (Register Publishing House, Ann Arbor, Michigan, 1885), in which he gives a fair and faithful review of the subject he has in hand. The part of the book which calls for most attention is that relating to the cause of cholera. Dr. Palmer thinks the disease to be "essentially produced by a peculiar poison, the exact nature of which is not yet fully demonstrated, but which is aided in its production and diffusion by certain local conditions, the chief of which is filth." The effects of the poison, he contends, are early manifested upon the ganglionic or organic system of nerves, and generally, among the earliest and most important morbid effects which the paralysed and deranged condition of the nervous force produces, are congestion and irritation of the intestinal mucous membrane, and profuse exhalations from its surface.

These views, as explanatory of all the phenomena of cholera, of the rapidity of the symptoms, of the course of the symptoms, and of the pathology, cannot be too widely diffused. From Professor Palmer they come with admirable and opportune force.

DEATHS FROM ETHYL BROMIDE AS AN ANÆSTHETIC.

I AM indebted to Dr. Henry Leffmann, of Philadelphia, for correction of the statement on page 264 of last Asclepiad, that there had been no death as yet in the human subject from the inhalation of ethyl bromide. Dr. Leffmann calls my attention to the fact that a death from this anæsthetic did occur in a youth eighteen years of age, who was about to be operated upon for lithotomy by Dr. R. J. Levis at Jeffreson College Hospital. The case is reported in the "Proc. Ph. Co. Med. Soc.," vol. iii., 1880-1, by Dr. John B. Roberts. Readers of The Asclepiad will do well to turn to page 264 of last number, and in line three from the bottom change the word "no" into "one."

PNEUMONIA AND OZONE.

DR. ANIEL DRAPER, Director of the Meteorological Observatory at New York, has drawn attention to the connection which seems to exist between what the late Dr. Moffat called ozone periods and pneumonia. He supplies a table showing the deaths from pneumonia, the amount of ozone, and the number of days in which ozone occurred in each year during January, February, March, April, and May, from 1878 to 1885, in the City of New York. The figures of this table show a close connection between the presence of ozone and pneumonia. Thus in 1885, while the death-rate from pneumonia rose to 2308, the ozone had increased to 13·26 on eighty-seven days, while a similar correspondence occurred in the other years. In the paper read at the Epidemiological Society in its early days by Dr. Moffat and myself on Meteorology in relation to disease, this same relationship was very carefully pointed out, and, at the Meeting of the British Association for the Advancement of Science, held at Birmingham in 1865, I reported from a long series of experimental results, that, at a temperature of 75°, air charged with ozone produces in the human subject acute catarrh, and in the lower animals, long exposed to it, congestive bronchitis and pulmonary congestion, often rapidly fatal.

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